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NOTE

In connection with the administrative reorganization of FAO, it has been decided that the name of each division shall be confined to one term only, and accordingly the Division of Forestry and Forest Products will in future be known as the "Forestry Division". This change will not involve any modification in the Division's activities or responsibilities. The term "forestry" as interpreted by FAO covers both management and conservation of forest resources as well as production, distribution and consumption of forest products.

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Cover photograph: "WILD LANDS" CONSERVATION. The runoff from an overgrazed winter range, 20 miles south of Hawlins, Wyoming, U.S.A. during a rainstorm. (Photograph by courtesy of U. S. Forest Service.)

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A Program for Range Lands

By Lyle F. Watts
Chief, United States Forest Service

THERE are vast areas of the world's surface, often physically associated with forest lands, which are neither forest lands proper, nor agricultural lands, nor improved pasture lands. These areas are covered with native vegetation whose conservation is of primary importance for soil protection and water control; they are often used extensively for grazing both by wild life and by domestic herds. The wise utilization of these lands — commonly called "range lands" in the United States — is a complement to, and in many cases, a condition of, sound forest utilization. The term "range lands" is not, however, readily applicable to similar conditions in other countries. It has been suggested that "wild lands" might correspond in non-American parlance to what the author has in mind. While in many countries such lands are too often subject to misuse, the United States Forest Service controls an important part of their "range lands" as federal property. In the following article, the Chief of the U.S. Forest Service shows the importance of this control.

In the development of the FAO program, emphasis has been placed on the problems of production on cultivated croplands, on improved permanent pastures, and on commercial forest lands. The range lands, the wild grasslands, the native forage-producing lands which constitute a large part of the earth's surface have so far been given little attention. It is the purpose of this paper to call attention to the need for an active program for these range lands. Some of our experiences in the United States of America can be cited to indicate both the need and the possibilities of such a program.

The range lands of the world occupy more than half of the earth's entire land surface. They include grasslands on all continents that are too dry, too rough, or too rocky to be used to produce cultivated crops. They include open forests and savannas where much grazable vegetation occurs under the scattered tree growth. They include desert shrub types, mountain meadows, and alpine grasslands near or above the timber line. They include the tundras of the far north.

Millions of people, nomadic herdsmen and others, gain a livelihood from these lands. Many more millions derive all or part of their living from processing, transporting, or selling the meat, wool, hides, milk, and other animal products produced on the wildland ranges. Just how much of the world's meat supply comes from natural range lands is not known, but it must be a high proportion. In the United States of America approximately half the beef cattle and 70 percent of the sheep get a considerable part of their feed requirements from native ranges. Livestock production from the range lands is the principal support of many communities in the western United States; and here and in many other parts of the world natural ranges help to meet the forage needs of farm operations, supplementing the cultivated or improved tame pasture lands.

Ever since the days of the United Nations Interim Commission for Food and Agriculture, when the groundwork was laid for a world food and agriculture organization, I have been concerned that so little attention was given to the problems of the range lands. Any program for expanding the world's production of food and fiber, and for improving the standard of living of the world's peoples, must look to the conservation and wise use of these lands. The range lands must be reckoned with because they represent a major portion of the earth's land surface, and because vast numbers of people are dependent upon these lands for their subsistence. Many of the world's range lands have been long and sorely abused and neglected, but because of their tremendous extent they still support vast numbers of animals yielding vast amounts of animal products. In addition, many of the world's ranges have potentialities for far greater production, and thus for much greater contributions to human welfare.

Range lands often support agricultural economies that differ materially from those based on croplands. It is reported that more than half of the range land of the world is grazed by nomadic herding; that is the way of life of many tribal people of Africa, inner Asia and the Asiatic tundra. In other areas, such as the western United States, the steppe lands of South Africa, the dry interior grasslands and savannas of South America, and in Australia and New Zealand, livestock ranching is practiced. This is a commercial form of livestock grazing, based on use of the native forage in large privately owned ranch units or on publicly owned range lands in the vicinity of a home ranch.

Other systems of range land use are practiced in the Mediterranean region, parts of the Americas, and elsewhere. In densely populated areas where there are many subsistence farmsteads, the livestock are commonly allowed to graze on native forage-producing lands adjacent to the farmsteads. Only under such intensive livestock farming systems as those practiced in most of western Europe, the American cornbelt, and cultivated parts of Argentina is the use of native forage insignificant. In these areas, livestock growers obtain their feed and forage from grains, hay, and intensively managed pastures. There is little native range forage.

Range lands have served man since before the dawn of recorded history. One of prehistoric man's earliest and greatest steps toward civilization was undoubtedly when he came out of the trees and caves and began to domesticate and herd grazing animals. It is said that Neolithic man brought sheep, goats, and cattle into Western Europe about 10,000 B.C. Livestock

Invasion of some 60 million acres of grassland ranges in the southwestern United States by mesquite has reduced grazing capacity, increased erosion and increased costs of handling livestock, as shown in these pictures. Above, an Arizona range area photographed in 1903. Below, the same area in 1941.

A depleted and actively eroding range area, once a mountain meadow (Utah, U.S.A.). It has practically no grazing value in this condition and the soil eroded from it may damage irrigated farming areas in the valleys below. (*This photograph and those printed on Pages 52 and 54 appear through the courtesy of the* U.S. Forest Service).

production from native forage helped to support the ancient civilizations of Mesopotamia, Egypt, Greece, and Rome. Over-grazing of the range probably was one of the causes contributing to their decline.

For the most part, the history of range use has been one of resource depletion. Centuries of heavy grazing have killed off the vegetation over extensive areas, laying bare the soil surface to wind and water erosion that has carried away the fertility of the land. The capacity of the land to produce usable vegetation has been reduced or destroyed.

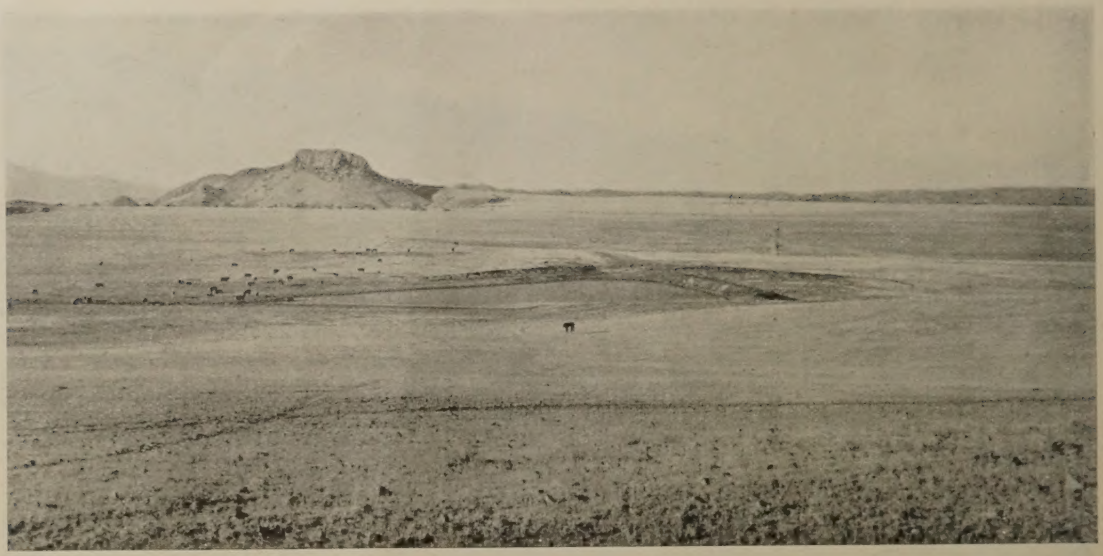
As a result of continued heavy grazing, too, the capacity of the soil to absorb precipitation has been lowered in many areas. A greater proportion of the rainfall runs off. Lack of protective soil cover causes excessive evaporation of the water that does get into the soil. This has caused desert conditions in many areas that otherwise would be mesophytic, or at least only semi-arid. It has caused sparse vegetation where it could be produced in abundance. It has caused human poverty where higher living standards could have been possible.

In other situations, constant heavy grazing of the better forage-producing plants has caused these to give way to unpalatable or grazing-resistant plants. The worthless plants have grown to dominate the areas, using up available moisture and nutrients in the soil. As a result, grazing capacities have been reduced to perhaps a tenth or a twentieth of what they could be. This has happened in parts of the range lands of the western United Stetes, where low-valued big sagebrush (*Artemisia tridentata Nutt.*) and other worthless plants have replaced valuable grasses and forbs. By reducing the sagebrush and re-establishing grasses, range managers have restored some of these sagebrush lands to high productivity. But vast areas of range land here and in many other parts of the world are now dominated by vegetation that is of little value to the peoples dependent upon these lands for their livelihood.

Many areas where irrigation is practiced, or has been practiced in the past, depend upon water from range lands or upon water that drains through range areas. Over-grazing in many cases has resulted in increased floods and sedimentation that curtail the amount of usable irrigation water, change its seasonal distribution, or fill irrigation reservoirs and ditches with erosion debris. Such effects of excessive grazing on watershed lands has caused the abandonment of some of the elaborate irrigation systems of the past in various parts of the world, and the consequent decline of local economies based on irrigation agriculture. Over-grazing is threatening irrigation works in many places today.

Range deterioration is a creeping paralysis. The progression of the sickness is not noticeable from day to day. The changes that result in lowered production from the range land usually occur very slowly; they may continue over many years or decades. The landowner or herdsman, trying to make a living from the range, may not recognize that the land is getting less productive; if he does, he may not know the reason for it. As deterioration advances, however, it also becomes more rapid. As conditions become progressively worse, the site gets progressively drier and less productive. Drought accentuates the rate of deterioration.

In the United States of America, the settlement of the western range country and the expansion of the range livestock industry was relatively rapid. Deterioration of some of the range lands has been correspondingly rapid. Perhaps for the first time, therefore, it has been possible to observe the causes and effects



Water is important as well as forage. This dam across the line of drainage has impounded sufficient intermittent stream flow to permit grazing the adjacent range throughout the year.

of range deterioration within the lifetime of a singleman.

Range lands can and should be managed for permanent productivity. Desirable objectives of range management would be :

1. to produce the maximum forage possible from range land on a continuing basis ;
2. to increase the forage production of range lands that are producing less than their potential ;
3. to make the most efficient use of the forage for the production of livestock and livestock products, or wild life, or both ;
4. concurrently, to safeguard or improve the watershed value of range lands for the mitigation of destructive or wasteful flood run-off and erosion and for production of maximum yields of usable water ; in many areas watershed considerations may be the most important of all.

Ranges are the habitat of much of the world's wildlife resources. For some of the more primitive tribes in various parts of the world, the wild game of the range is still the principal basis of subsistence. Big game hunting supports guide and outfitting services, helps to increase tourist and travel business, and thus contributes to the economy of a number of regions. In such places, the maintenance of abundant populations of big game may be a principal objective. As with domestic livestock, the key to thriving big-game populations is abundant forage of suitable types. Wildlife management is primarily habitat management.

Within recent years, range management has been developed as a science, with scientific principles evolved for the handling of range land and the management of livestock grazing on native forage. Research on range management problems has been under way in several countries, such as the United States of America, Australia, South Africa, India, and Pakistan.

In the United States, the application of scientific management to range lands has developed during the last fifty years. This came about partly as a result of experience gained by livestock owners and by public land management agencies in the use of range lands. A major contributing factor has been the range research program of a number of state agricultural experiment stations and the U.S. Forest Service. Range management studies in the western United States began on a limited scale about 1900. During recent years the research work has been much expanded and has been extended to many range types in the western and southern parts of the United States. The results of this research have been made available for use both on publicly owned range lands administered by the Forest Service and other governmental agencies and on range lands in private ownership. Educational activities of a number of federal and state agencies are helping to get research results into wider practical application on private lands.

Improved Use of Forage Plants

As a result of research and experience, range managers in the United States are learning to manage the range in such a way that the better forage species increase and remain productive. They are learning techniques for rehabilitating depleted range land by reseeding, and for reducing dense stands of shrubs and other noxious plants having little or no forage value and replacing them with valuable forage plants.

To encourage the better forage species, the range manager must consider both the needs of the desired forage plants and of the livestock. He must provide for keeping the desirable plants productive by regulating the grazing to leave sufficient herbage to nourish the plants, and by lessening or discontinuing grazing during critical periods in the growth cycle of the plants, at least on a part of each range unit each year. To gain efficient use of the forage, proper distribution of the livestock on the range must be obtained, and only the class of livestock best suited to the particular type of forage and to the topography should be grazed.

Numerous range management practices developed through range research by the U.S. Forest Service are now applied on many range units in the western United States. On these well-managed ranges, the dates for turning livestock on to a range and for taking them off are set to harmonize both with the readiness of the range for grazing and with the nutritional requirements of the livestock. Fairly good bases for determining the approximate grazing capacities of various range types have been worked out. Deferred and rotation grazing is an improved practice which permits proper use of the forage on the range as a whole, but delays grazing until after seed dissemination or forage maturity on a different portion of the range each year. Improved methods for grazing sheep and goats have been developed, such as open and quiet herding and bedding down the animals in a new place every night to avoid damage through trampling and localized overgrazing. Better distribution of cattle is being obtained through well-placed watering facilities and better salting methods, thus bringing about a more even and more effective use of the available range forage. Research has developed management practices that harmonize grazing with forest regeneration in open pine types in the western states. It has developed methods of management that minimize losses from poisonous plants, and measures for the eradication or control of many noxious plants. Economical procedures have been developed to reduce the stand of some of the low-value shrubs so that grasses can make greater growth.

By such management practices it is hoped that the productivity of much run-down range land in the western United States will be restored, and that high productivity, once achieved, can be permanently maintained.

The U.S. Forest Service has also done much research on range reseeding as a means of restoring depleted range lands to the productivity of which they are capable. About 80 million acres (32,376,000 ha.) of range land in the western United States are so badly deteriorated that natural revegetation within a reasonable time appears improbable. Intensive studies and experiments have been made to determine the adaptability of various species and strains of forage plants for many of the various range situations. Native plants, species introduced from other lands where they grow naturally under more or less similar ecological conditions, and improved strains of both native and introduced species have been tested. Experiments have been conducted to determine how much seed to plant of each adapted species, the depth of planting required to attain satisfactory establishment, and the best season for planting. Special machines have been devised for use in planting and to reduce competing vegetation. These studies and experiments have developed efficient and economical procedures for the successful establishment of adapted species on a number of different range types.

Importance of Re-seeding

As a result of these studies and experiments, it is now possible at reasonable cost to reseed badly depleted areas in a number of range types and make them productive in from one to three years, where it would require half a century or more for them to recover naturally. More than 8 million acres (3,237,600 ha.) of private and public range land in the western United States has already been seeded successfully. The seedings have increased forage production 5 to 10 times — in some cases, 15 to 20 times.

On the forest ranges of the southern United States, research on reseeding techniques is looking to the establishment of plants that will extend the season of palatable and nutritious range forage, thereby reducing the necessity for feeding costly supplements now essential for sustained livestock production in this region.

The potentialities of scientific range management in increasing and stablizing livestock production are great. As an example of what can be accomplished in a practical way, the Jornada Experimental Range in the southwestern United States of America might be cited. This experimental range, maintained by the U.S. Forest Service, is located in the subtropical desert region of southern New Mexico. It is 193,000 acres (78,107.1 ha.) in extent. It receives an average annual precipitation of about 9 inches (228.6 mm.). Drought years are frequent; in some years less than 4 inches (101.6 mm.) precipitation occurs. Three to four years of every decade are drought years.

In this area, the production of beef per cow has been practically doubled in the past 30 years, giving greater total yields of beef from the same area. This was accomplished by stocking the range so that sufficient herbage would be left after grazing to maintain plant vigor, by organizing the seasonal movement of cattle so as to use each vegetation type in its proper season, and by adjusting the ratio of breeding cows in the herd. Making adequate range forage available to each animal resulted in greater weight increases per animal and lowered death losses. The number of calves per 100 cows increased from 65 to 85. Also fluctuation in forage production from year to year has been reduced, lessening the adverse effects of drought.

Generally, management of range lands for an abundant and continuous production of forage will bring about good watershed conditions as well. Where critical watershed problems exist, special treatments of the range may be necessary. It is often possible to improve watershed conditions by modification of grazing use. In the National Forests of the western United States, watershed condition as well as forage has become a criterion for setting grazing schedules and allotments. Severely damaged watersheds may be rehabilitated by revegetation and upstream engineering work such as contour trenching, construction of small dams to check gully erosion, etc. Research in forest influences is gradually developing more knowledge of how to manage various forest and range types and how best to conserve water, reduce wastage, and produce the highest usable water yield.

I cite these examples of the possibilities of scientific range management in the United States only because I have first-hand knowledge of them. Undoubtedly, examples of equally successful range improvement or of long periods of wise range use can be found in many other countries.

But the fact remains, as we all know well, that vast areas of range land throughout the world are badly deteriorated. Vast areas are producing only a fraction of the meat, wool, and other products they could produce. Range deterioration is aggravating

Sheep on summer range in a national forest of the mountain west (United States). Nutritious grasses and other forage produce high quality grass-fat lambs which go direct to market.

water problems in many areas, contributing to floods, erosion, and sedimentation on the one hand, and to scarcities of usable water on the other. My own country is no exception.

Conservation and wise use of the world's range lands should certainly have a place in a world food and agriculture program. I hope this forgotten half of the earth's surface will be given more adequate attention. Specifically, I wish to propose the formation of a Range Management Branch as a new major subdivision of the Forestry Division of FAO. This Range Management Branch would be concerned with the compilation of information on the extent, character, condition, and use of the world's range lands; with encouragement of more research and exchange of technical information on range management problems by the member countries of FAO; and with co-ordinating, stimulating and guiding the work of public and private institutions throughout the world toward the rehabilitation and efficient and productive use of range lands. It would seek to do for the range lands what the forestry and crop branches of FAO seek to do for other portions of the earth's surface.

There are a number of reasons for suggesting that the Range Management Branch be set up in the Forestry Division of FAO. The principles of range management differ greatly from those of management of croplands or intensively handled pastures where returns per acre are relatively high. Range management, like forestry, looks to the conservation of renewable natural resources. It is closely related to forestry because it is a form of land management that involves the growth and harvest of native plants. A large part of the range lands also are forests where the forage is obtained from the shrub and herbaceous vegetation that grows in the understory. Production both of wood and of forage may be obtained through correlation of uses of the land.

Range management problems should be handled by specialists in range management — by men who are trained in the management and use of natural herbaceous and shrub vegetation where many species occur in complex association. Many, perhaps most, of the range management specialists today are men who have a combined forestry and ecology background. Where courses in range management are given in the universities they are generally given in connection with the forestry curricula.

Foresters in the United States and in several other countries have led the way in working for more efficient use of range lands. Working with other ecologists and co-ordinaing their efforts with agronomists and animal husbandmen, foresters evolved the science of range management, conservation, and improvement. I should like to see foresters take the lead in a program for range conservation and improvement throughout the world.

The ultimate objective of range management, as of forestry or crop agriculture, is of course human welfare. Conditions in thousands of communities and even great metropolitian centers reflect adversity or prosperity on the range. All too frequently; improper management or abuse of the range has resulted in reduced livestock production; in far-reaching damage from floods, erosion, and siltation, in impoverishment of peoples and weakening of nations. Production from the range land can be increased, the lot of peoples dependent upon the range resources can be improved, and the economy of communities and nations strengthened and stabilized when improved range management is applied. It is my hope that the Food and Agriculture Organization of the United Nations will take a leading part in the development of a program to make that half of the world's surface that is range land contribute its share fully and continuously to the welfare of the world's peoples.

The Poplar - Its Place in the World

(Current Research and Future Work Programs)

By Jean Pourtet

Inspector-General of Waters and Forests, Nancy, France

POPLARS (genus *Populus*) together with willows (genus *Salix*) constitute the family *Salicaceae*. The genus *Populus* comprises five divisions or subgenera: *Leuce* (aspens and white poplars), found throughout the Northern Hemisphere; *Tacamahaca* (balsam trees), in Asia and North America; *Aegirus* (black poplars), in the temperate zone of the Northern Hemisphere; *Leucoides*, in southeastern North America and in the Far East; and, finally, *Turanga*, in the Mediterranean basin.

The poplars of the first three subgenera play an important role in world economy; about 5 million cubic meters of white poplar and balsam wood are produced in a wide circumboreal zone outside the U.S.S.R.; 3 million cubic meters of black poplar wood are grown in artificial stands in Western Europe and about 2 million cubic meters of varied types in the Mediterranean basin.

History

Little has been recorded concerning the aspen and even less concerning the balsam poplar, because these trees are important only in natural stands and have been cultivated only exceptionally. The black poplar, however, has an interesting history.

The first poplars introduced from America and the East into France were intended only for ornamental purposes and as park trees; through grafting it became possible to propagate, rapidly and indefinitely, each of the types introduced, even single specimens.

Because of this, poplars trees soon became widely known and appreciated, whereas normally a long period of time, frequently a century, elapses between the introduction of a tree species by seed and its large-scale use in afforestation. The rapid growth of these trees made possible early crossings of new species with the native *Populus nigra*. The first American poplars were introduced into Europe at the end of the eighteenth century. Henri-Louis Duhamel de Monceau, in 1754, mentioned the results obtained in his poplar plantations, giving details concerning the ecology and technological qualities of the poplar and its timber.

Hybrid poplars were planted at the same time, certain specimens of which are still alive; for example, the *P. euramericana* f. *serotina* planted in 1752 in the Botanical Gardens of Nancy. This has attained a girth of 6.30 meters at 1.30 meters above ground.

Some of these hybrids were reimported into America by emigrants. Thus, at the beginning of the nineteenth century, François-André Michaux, a naturalist and explorer in the eastern United States of America, was uncertain as to the classification of the black poplars found in the New York region. In his remarkable treatise on trees of North America[1] reference is made to the "Swiss or Virginia poplar", a tree widely cultivated in Europe which, although it was not encountered, "is probably native to some part of America."

During the nineteenth century, intelligent empirical experimentation led to the selection of a few valuable hybrids. These became an important feature of the French countryside and a valuable source of production. Gradually, these hybrids spread to other Western European countries.

A comprehensive study of poplars undertaken at the beginning of the twentieth century by the French botanist, Louis Albert Dode, failed to achieve practical results, because of its oversystematic treatment. Later, the work of such men as Edmond Henry, Candsdale, Gijsbertus Houtzagers, Regnier, and Piccarolo, contributed toward a re-orientation of theoretical studies along practical lines.

Since 1947, most of the widely dispersed research has been co-ordinated within the International Poplar Commission under the chairmanship of Prof. Philibert Guinier.

Identification and Nomenclature

The International Commission, for practical reasons rather than for the sake of pure science, undertook as its primary task the establishment of identification and nomenclature of poplars. Great confusion had prevailed in this field since the eighteenth century, when François-André Michaux referred to the same tree by two different names, "Swiss poplar" and "Virginia poplar." The facile propagation of poplars and their commercial value had led to the use of an infinite number of names for the same tree species. The complex situation arising from the empirical outlook of certain poplar growers, who were indifferent to nomenclature, would have rendered impracticable all international or regional exchange of poplar seed or grafts. It would also have led to disappointments.

The International Commission labored for two years before completing the nomenclature of black poplars. Three major botanical groups were established, namely:

(a) *Populus nigra* L.: Old world black poplars;

(b) *Populus deltoides* Marsh: Black poplars of eastern North America;

(c) x *Populus euramericana* (Dode) Guinier: Hybrids derived from crossings of the two above species.

Each of these groups is divided into several subgroups containing various selections usually designated by local common names.

(a) *Populus nigra* L:

P. nigra f. *italica*: the fastigiate male, grown for ornamental purposes throughout the world, and for industrial purposes around the Mediterranean.

[1] *Histoire des arbres forestiers de l'Amérique septentrionale*. Paris, 1810-13, 4 vols.

P. nigra f. : the "Vert de Garonne" (France)

f. : the "Hamoui" of Syria and others in the Mediterranean area : very erect female trees yielding timber which is valued for carpentry.

(b) *Populus deltoïdes* Marsh :

P. deltoïdes f. *carolinensis* (♂) and *angulata* (♀): southern types with excellent timber, but requiring a great deal of care and difficult to graft.

P. deltoïdes f. *missouriensis* : of erect stance ; the male was introduced into the Netherlands and is still cultivated there.

P. deltoïdes f. *monilifera* (♂) and f. *virginiana* (♀): types resistant to cold and of rapid growth ; the female widely grown in France.

(c) x *Populus euramericana* (Dode) Guinier :

These vigorous, rapidly growing hybrids are found throughout Western Europe and have been distributed commercially throughout the world. There are numerous clones, the main groups of which are listed below :

x *P. euramericana* f. *serotina* : male, with late leaves, cold-resistant, excellent timber.

P. gelrica : selectively grown in the Netherlands, apparently closely related to the preceding type.

xx *P. euramericana* f. *regenerata* : female with deciduous catkins ; excellent timber, but susceptible, under certain circumstances, to oozing canker (Fr. *chancre suintant*), a serious disease.

x *P. euramericana* f. *robusta* : male, with very early leaves, remarkably straight and erect trunk. It is of comparatively recent origin. and has spread over the entire world, although it requires great care and its timber uses have not yet been explored.

x *P. euramericana* f. I-214, 155, etc. : excellent hybrids selected in Italy by Prof, Piccarolo and well adapted to the favorable conditions of the Po valley.

In the future, any new types evolved or appearing spontaneously will be designated by a number preceded by the initial letter of the name of the country where they originate. They can thus be added systematically to one of the groups already mentioned.

The International Commission also specified, for practical purposes, the characteristics to be noted in the determination of species, namely : the date at which the leaves appear, the sex of the tree, erectness of the trunk, the characteristics of the bark and of the branches, the type of fruit borne, etc. On a recent trip to the United States of America, a group of European experts had occasion to clarify several obscure points.

No difficulty was encountered in establishing the nomenclature of balsam poplars, in which clones of species and varieties need not be distinguished by a binary system of nomenclature.

White poplars are not very common, except aspens : *Populus tremuloïdes* Michx. and *grandidentata* Michx. in America ; *P. tremula* L. in Europe in two forms : one, with large, glabrous leaves, found in the boreal zone and in mountainous areas ; the second, with small villous leaves in the early stages of growth (var. *villosa*).

Southern white poplars are characterized by a persistent coating of down on the underside of the leaves (tomentose). In botanical gardens and arboreta, the following types from the Mediterranean region are found : *P. nivea* Willd, *Hickeliana* Dode, *subintegerrina* Lange, etc. In the forests of Europe, the orphan hybrid, the result of a cross between the aspen and *P. nivea* : *P. megaleuce* Dode (Ypreau or "blanc de Hollande") and its close relative, *P. canescens* (Grisard), occur.

However, less is known of the comparative qualities of these types, their ecology, and methods of propagation.

Creation of New Types

As previously mentioned, nurserymen and planters, until the twentieth century, were content merely to propagate the types of trees growing spontaneously, or hybrids which they found most valuable because of their rapid growth or their resistance to certain natural enemies. Many types selected in France during the past hundred years are still being multiplied and planted throughout Western Europe, competing with the best of the more recent types evolved.

It was considered necessary, however, to increase the range of types offered for selection by planters and, therefore, to attempt systematically to evolve new types ; this was undertaken after the first World War by the Institute for Poplar Culture at Casale Monferrato in Italy.

Artificial hybridization was used, and seed was also gathered from the best female trees ; the latter method, which does not afford any means of positively ascertaining the male parent, has the advantage, however, of yielding a great number of hybrids, from which further selections may be made.

Results have been excellent : numerous new types have been evolved, which are sufficiently resistant to the more serious diseases, are of rapid growth, and have good technological properties.

Similar experiments are now under way in France and in other European countries, Good results cannot be expected of this method everywhere, because some trees are sensitive to winter or autumn frosts and also because the soils on which they are planted are generally poorer than the soil in the Po valley.

In Germany, research is basically concerned with the selection of species suited to each type of soil and of trees which can stand rather dry climates ; poplars are not very common except in the Rhine valley, where they are widely used as forest trees. The same applies to Switzerland, where the most valuable trees were selected without concern as to their position in the systematic classification.

The Swedes have evolved new aspens of very rapid growth, either by the process of heterosis (*P. tremula* x *tremuloïdes*) or by increasing the chromosome number (*Tremble triploïde*) : these do not seem suitable for lower latitudes, probably because the days are too short.

Finally, in the United States of America, until recently, research was aimed exclusively at the evolution

and selection of hybrid crosses between black and balsam poplars.

Each country, therefore, should undertake and pursue its own research for the evolution of new types best suited for its requirements. It is clear that it will not be possible to improve on past results in cultivation but we may expect to improve the technological properties and the disease-resistance of the trees.

The creation of a "Populetum" or collection of poplars is current practice in many countries. This will make possible the comparison of old and new types; in France, 70 different types have already been planted side by side in the Loire valley near Blois.

Propagation and Cultivation of Poplars

In practice, black poplars and balsams are propagated almost exclusively by grafting; the technique is simple and only a few types require special precautions to ensure success, such as the irrigation of nursery beds. No effect upon growth has been noted from the use of plant hormones.

Grafts must be taken from young trees and, if possible, from the tree tops. In this way, i.e., by using grafts from elite trees, the mother-trunks can be converted into pollards which furnish excellent grafts. Approximately every ten years, new pollards are required. Austria, Czechoslovakia, Germany, and the Netherlands have contributed to perfecting the grafting technique.

It is more difficult to graft white poplars: aspens are complete failures; white poplars proper, and particularly the southern types, are more successful. However, the use of such propagation methods is rarely feasible financially.

The Danes and the Swedes have perfected a method of greenhouse propagation by grafting budding, green suckers; to be both useful and practicable, this technique still needs to be perfected and simplified. Work along these lines has been undertaken at the French Forestry Research Station.

In Canada, aspens have been crossed with other members of the same group in an attempt to facilitate grafting.

The rules for the cultivation of poplars have been evolved gradually and mostly empirically. In the majority of countries where this tree is grown, plantations are still far too dense. Experiments conducted over several years on experimental plots in Belgium, France, and Italy have proved that only poplar stands with a maximum of 200 stems per hectare are economically profitable, yielding the best assortment of products. Research in these countries has demonstrated the relative ineffectiveness of thinnings. Observations made by a recent international mission to the United States of America indicated that the same rules apply to hybrid balsam trees; it is a fact that dense plantations have consistently failed instead of producing the magnificent yields expected by the theorists.

Aside from such thick poplar stands, there has been successful cultivation of poplars in rows, while, in some regions, poplars have been introduced into regular forest stands.

Information concerning suitable types of soils for poplars is generally good. The art of pruning is also far advanced. Research has shown that poplars should attain a minimum girth of 1.20 meters [illegible] are to be commercially profitable. Trees of sufficient size are also preferred for pulp.

Enemies of Poplar Trees

These are both numerous and varied, ranging from mammals which eat the bark (rabbits, squirrels, and other small rodents in Western Europe; deer in North America) to the unknown bacteria which cause canker.

Most parasites exhibit marked selectivity; growers, therefore, require a knowledge of the position in the systematic classification of the trees they intend to grow and of their pests: for instance, the mistletoe of Western Europe (*Viscum album* L.) does not attack *Populus nigra* L., but does live on all the Euramerican hybrids. The unknown causal agent of oozing canker selects its victims even more carefully: among the Euramerican hybrids, it damages only the *regenerata* type and is only dangerous in the northern part of the area where this type grows.

The two above-mentioned poplar parasites attack healthy vigorously growing trees. Others, i.e., insects and fungi, destroy leaves, while still other insects bore holes and galleries in the wood.

On the other hand, many enemies of poplars only attack the trees when their resistance is low: parasites of sickly trees and deficiency diseases are prevalent in too densely planted stands or among trees planted under unfavorable ecological conditions. These are the most frequent cause of damage to poplar stands, but they can be avoided through proper silvicultural practice.

The International Commission recommended that its member countries make a survey of the enemies of poplar trees. This will bring together widely dispersed documentation on the subject.

Uses of Poplar Wood

Poplar is used for many varied purposes because it is light, easily worked, and has good mechanical properties.

Sawn timber. This is the oldest use for poplar timber and the one for which it is best suited. We may disregard carpentry which is chiefly important in the Mediterranean basin, because of the special properties of *Populus nigra* (*forma italica* in the West) other types in the East, are frequently used as small round wood, as in Turkey.

In box manufacturing, where lightness is of prime importance, knotty lumber and logs of too small a diameter are frequently used. The manufacture of crates for furniture is an important industry in France: fluctuations on the furniture market greatly affect the price of poplar wood in the Paris area. In Belgium and the Netherlands, much poplar wood is used for the manufacture of wooden shoes (*sabots*). Wood of the white poplar is used in carpentry and for ship construction.

Veneer. Poplar wood is excellent for veneer-making without requiring prior treatment, when it is of good quality; in fact, it is the percentage of veneer wood

[illegible]

[3] This applies to Western Europe; in the Near East, on the contrary, small diameter poplar stands are considered most desirable.

in a log which determines its price. Boards of a lower quality are used for packing boxes. Good splinters are used for match-making. Select wood of sufficient length is used for plywood manufacture.

These main uses of poplar wood, as sawn timber and for veneer, have stimulated research in many countries, notably in Switzerland. This research is aimed at lowering the percentage of waste by the elimination of certain defects, and at determining the influence of the clone, of environmental ecological conditions, and of proper care upon wood quality.

It has been fully demonstrated already that certain types have better technological properties than others (for example the clone *P. deltoïdes* f. *carolinensis* cultivated in southwestern France) but, in most cases, conditions of growth and management, particularly pruning, have a much greater effect on the technological properties and on yields of select wood than the intrinsic qualities of the type cultivated. This explains the surprising divergence of opinion found among even the best informed growers.

Cellulose. Aspens and balsam poplars have long been highly valued as sources of paper pulp, but the use of black poplar for this purpose is comparatively recent. Italy is foremost in this industry.

French technicians have lagged behind in this respect. They are engaged in determining the best proportions for combination with other longer pulp fibers.

The manufacture of fiberboard is equally important in America and in the Scandinavian countries, but is still in an incipient stage in Belgium. The use of poplar wood for pulp and fiberboard manufacture is less profitable than for sawn timber and veneer. However, these industries afford an outlet for small size wood and logs of unsatisfactory shape.

Conclusion and Future Program

To date, good results have been achieved, thanks to the multiple efforts recently co-ordinated by the International Poplar Commission. They are summarized below.

Black poplars (Section *Aigerus*). The identification and classification of known types (either of wild or of hybrid origin) is on the point of being completed. As regards their nomenclature, a classification system has been established, into which new species may be fitted as they are identified. Furthermore, there now appears to be available a sufficient range of types to make possible excellent results from plantations on good, new, rich soil in the temperate zone of Western Europe. These types are sufficiently varied to supply the manifold requirements of our present-day economy, taking into account the special ecological conditions at the French Experiment Station and the danger of disease infestation.

While proper cultivation methods and rules have been well established, they still need to be applied more generally.

Balsam poplars (Section *Tacamahaca*). Further experimentation with this species and hybrids is required. Good results are expected in either the frigid or temperate zones.

White poplars (Section *Lance*). Only the Swedes have passed the experimental stage in their research and have put into practice some of the principles evolved. Elsewhere, natural stands are being felled and at times ill-advised plantations are being made due to insufficient basic knowledge.

The conclusions reached in this report point the way to future research. The following points require attention. First, the need for rich, alluvial soils of excellent quality, rarely found in extended tracts, if the poplars currently cultivated are to prosper. Second, insufficient present knowledge regarding the cultivation and possible industrial uses of the white poplars group, particularly the southern species. Third, the backwardness of research throughout the temperate hot zones, more particularly in the Mediterranean basin.

Research workers and growers should, therefore, direct their efforts toward :

1. *Research on types of poplars which can be grown on comparatively dry soils, of average or below-average richness.* This problem hardly concerns the northwestern European countries where the humidity of the atmosphere compensates for the deficiency of soil moisture. However, it is of capital importance in Mediterranean countries.

Black poplars of Eurasia (*Populus nigra* L.) are more resistant to drought than the southern types (*P. deltoïdes*) ; consequently, a study of the former may provide a solution.

In southeastern France black poplars of relatively satisfactory growth and shape are cultivated locally. By choosing the best of these, and selecting seed obtainable from them, and possibly, even by crossing them with Euramerican hybrids, it should be possible in a short time to grow trees producing marketable timber on soils where the growing of poplars has previously not succeeded. It is likely that a survey of the entire area where black poplars (*P. nigra*) grow would lead to the discovery of valuable clones.

In southwestern France and in the eastern Mediterranean basin, female clones of black poplar (*P. nigra*) of very erect stance, but not as slender as the Italian poplar, are grown : they are the " Hamoui " of Syria, and the " Vert de Garonne ", etc., widely used locally. Their improvement might prove worthwhile, particularly since in Mediterranean countries poplar wood is used for carpentry, which requires the special technological properties of black poplar. The leaves of the black poplar are also used as feedstuff for livestock.

2. *The scientific study of southern white poplars.* These types are little known or used, except in the Near East where a cultivated form, known as " Roumi, " a fastigiate form of *Populus nivea* Willd, is used for veneer-making.

While the studies of botanists have made possible a preliminary classification, probably incomplete and perhaps inexact, as further examination may show, our knowledge of the ecology, silviculture and utilization of this group is altogether insufficient.

(a) *Ecology.* These trees are resistant to high summer temperatures, and can live on comparatively dry and even salty soils. However, the variations in behaviour of the various types and their limits of endurance in the face of adverse factors such as drought, stagnant waters, and extremes of temperature need to be defined. It is no less essential to know under what minima conditions they still produce marketable crops. This leads to silvicultural considerations.

(b) *Method of cultivation.* We have practically no knowledge as to the best method of growing these trees. It is reasonably certain, however, that, like all poplars of the *Leuce* group, these trees will grow in denser stands than black poplars; on the other hand, the economic limitations of such adaptability have not yet been determined.

Vegetative propagation is much easier in the case of aspens; however, the details of this technique still have to be perfected.

3. *Scientific research on poplar wood.* All research should be constantly correlated with the technological research being done in the laboratories and in factories using lumber from stipulated small stands.

Only those species which have proven completely satisfactory as regards their suitability for forestry work, their sawing qualities, and paper- and veneer-making qualities, or any one of these, should continue to be propagated.

4. *The future progress of poplar culture in the hot temperate zone.* This will depend directly upon the solutions to the preceding questions and on research on the *Turanga* group. However, there are a few good alluvial soils in well-irrigated districts in the warmest parts of the Mediterranean area, which can be planted with black poplars with anticipation of good yields. It may also be predicted that the southern species *P. deltoïdes* Marsh and some hybrids now bred or selected at the Italian Institute of Poplar Culture at Cassale Monferrato will prove to be successful.

Forestry in Bolivia

By Henry S. Kernan

Member of the United Nations Mission to Bolivia

Whenever the balance sheet of the world's renewable natural resources is drawn up, the largest question mark stands beside the Amazon Valley. Centuries of exploration in her immense stands of hardwood timber have revealed the merits of a few dozen species out of thousands. But the Amazonian forest as a biological environment capable of producing wood and influencing the soil and climate has yet to be discovered.

Bolivia's share in this forest, and in the far poorer one on the Paraguay River, covers 128 million acres (51,801,600 ha.) and provides 32 acres (12.95 ha.) for every inhabitant. These facts rank her among the wealthiest countries in the world as regards forest resources.

There is no doubt that forestry should take a vital part in a prosperous and well-balanced economy, but the problem of integrating this resource into a culture based upon mining and highland farming cannot be overlooked.

This article attempts to deal with this problem. It avoids the prophecies and fantasies which often plague discussions of little-known tropical jungles. It is based upon facts from three sources: published material, interviews, and field observation. These facts are incorporated into a description of the various forest types and of the industry which has arisen to exploit them. The Government's efforts to regulate such exploitation and the question of safeguarding both the productive and protective aspects of forest land is then discussed.

The article intends to justify a forest policy of conservation and renewal. Such a policy, if followed, can protect Bolivia from the horrors that will inevitably follow from the destruction and neglect of her forest resources.

Forest Resources

Forested land in Bolivia covers about 128 million acres (51,801,600 ha.), or nearly 40 percent of the area of the Republic. The volume of sawtimber produced has been estimated at 256,000 million board feet (604,160,000 m^3) and the number of species at more than 2,000. In general, the various forest types are of extreme complexity, differing with regard to composition, size classes, and quality. They are made up of evergreen and deciduous hardwoods; for, with the very minor exception of *Podocarpus sp.*, there are no conifers. The richest forest is that on the eastern slopes of the Andes and along the rivers of the Amazon drainage. This forest is largely in a primeval condition. In eastern Bolivia, on the almost imperceptible divide between the Amazon and Paraguay Rivers, there is an equally large area of low, dry forest which has been profoundly modified by fire. The same geographical factors that shape every phase of Bolivian life have likewise determined both the character of tree growth and its present degree of usefulness. Physical barriers still separate the centers of population from the best forest lands and thus give to their timbers a value more relative to the means of transport than to their inherent qualities for industrial use.

The forests around Mt. Sajama, near the Chilean border, offer a striking example of this fact. They are composed exclusively of a small, slow-growing and gnarled member of the rose family called keñua (*Polylepsis tarapacana*). The wood of this tree can yield excellent fuel and charcoal, but has no other use beyond supplying short poles for fences and huts. Undoubtedly the keñua was once more widespread; but for centuries the Aymara Indians, desperate for fuel in

their harsh climate, have been cutting down these trees until now they remain only in one remote and almost uninhabitable district of windswept puna. Thus a species of poor natural qualities has attained a high value and has almost been destroyed because it was relatively accessible.

Elsewhere the Altiplano is treeless, and the landscape is only occasionally varied by the native kishuara (*Buddleia sp.*), or by such exotics as eucalyptus (*Eucalyptus sp.*), pine (*Pinus insignis*), or cypress (*Cupressus sp.*), which have been induced to grow around occasional houses.

East and southeast of the Altiplano there is a broad belt of steep slopes, narrow valleys and sharp peaks which are formed as the Andes drop off toward the eastern lowlands. As the climate becomes milder and the rainfall higher at the lower elevations, tree growth is more prominent. It is said that parts of this area were once heavily forested with such valuable trees as Spanish cedar (*Cedrela sp.*) and walnut (*Juglans sp.*), but this is a moot point.

The fact is that tillage and grazing have so exposed these soils to wind and rain that erosion has reached an advanced stage. Tree growth is now confined to a scattering of scrubby legumes (*Leguminosae*), molle (*Schinus molle*), and willows (*Salix sp.*). These are seldom allowed to reach maturity. They are gradually being hacked to pieces for fuel and small building material, and forest associations that could stabilize the soil are not allowed to develop.

Afforestation has so far been largely confined to the valleys about La Paz, Cochabamba and Sucre. Here a veritable rush for planting eucalyptus is taking place. The Bolivian Railway Company and the University of Cochabamba maintain nurseries and grow fuelwood and mine props on a commercial rotation of five to ten years. With the help of the Extension Service at Tamborada, which distributes 15,000 seedlings each year, innumerable landowners have entered the business. These enterprises have often shown excellent profits, but are severely limited by the fact that eucalyptus needs fairly good land here and cannot grow quickly without irrigation.

The Yungas lying eastward from La Paz have a natural cover of dense forest on account of the mild climate and high rainfall. Before they were largely destroyed by careless and excessive cutting, the quina trees (*Cinchona sp.*) of this area provided the world's highest grades of quinine bark. The Yungas have also yielded some castilloa rubber from the caucho tree (*Castilloa sp.*). Little use, however, has been made so far of the excellent woods because the steep mountainsides and narrow valleys preclude extensive and low-cost logging.

The forest region of most immediate interest and probably of most permanent value lies among the eastern foothills of the Andes and out on to the flatlands in a belt of varying and ill-defined width. From Yacuiba on the Argentine border north to Santa Cruz, such hard and heavy woods as walnut, quebracho (*Schinopsis sp.*), and various kinds of tajibo (*Tabebuia sp.*) predominate.

At Santa Cruz the forest turns and follows the Andes northwest through a region of high rainfall (1,500 to 2,000 millimeters) and excellent soils that extends all the way to Peru. In this belt are found the finets stands of tropical hardwoods in Bolivia. They can favorably be compared with those of other countries. The topography, between mountains to the west and llanos to the east, is flat to rolling and is generally well drained. The climate and low latitudes (14^0 to 18^0 S.) ensure rapid growth. Apart from palms and inferior woods, there is a usable average of about 10,000 board feet (111.9 m^3 per ha.) to the acre. The development of individual trees is often superlative and the variety of genera almost beyond belief. A typical square mile would reveal over a hundred varieties, and at least twenty-five with outstanding properties for industrial use, including mahogany (*Swietenia sp.*) of excellent quality.

More remote but equally rich in fine woods is the vast and dense jungle that lies between Peru and the Beni River and broadens northward to include the whole Department of Pando and the neighboring Province of Vaca Diez. An extension of the same type follows the Guaporé River southward along the Brazilian frontier to its headwaters and those of the Paraguay River. Besides mahogany, this forest also has Para rubber (*Hevea sp.*), especially toward the north where several rivers converge to form the Madeira.

Eastward from Santa Cruz rainfall becomes less and the dry season more marked. Tree growth becomes lower, more open, and of poor quality for anything but railway ties, planks and fuel.

Problems of Forest Resource Development

Certain obstacles to forestry in Bolivia are fundamentally the same as those which other tropical countries have met and are solving. With their experience to draw upon and with the demand for wood at a very high level, Bolivia is fortunate in having her timber resources largely intact.

Difficult and remote terrain coupled with a poorly developed transportation system is the most prominent obstacle to be dealt with. The best forests receive torrential rains and are near rivers that flow away from the centers of population instead of toward them. Moreover, not a single first-class road or railway connects them with the Altiplano. Any further development of the forest resources, therefore, presupposes that rail, road, and water transport becomes increasingly available; and conversely that planned forest exploitation and industry integrated with other forms of economic progress can stimulate and pay for this transport.

The bewildering complexity of a tropical hardwood forest and the high proportion of hard, dense woods create further problems of utilization that have not yet been solved. The present tendency is to use only by-products or a few high-value trees and thus bring about a progressive deterioration in the composition of the forest.

The difficulties of complete utilization require a rather complicated type of milling and marketing process. It can only be sustained by a high level of economic activity which can supply the capital and absorb the products. Bolivia's over-dependence upon the ups and downs of the mining industry and the stagnation of economic development in other fields are not conducive to the orderly and sustained development of her forest resources.

The influence of land ownership upon forestry has long been recognized and studied. The verdict has been the same in country after country, and proves beyond doubt that forestry only progresses where land tenure is reasonably clear and stable, where ownership bears some relation to the size of the economic units to which they are attached, and where at least a modicum of land is under permanent public ownership.

Unfortunately Bolivia inherited from colonial Spain a pattern of land ownership which has not fulfilled these conditions. Titles and boundaries are in a thoroughly chaotic state and will become the subject of endless litigation as land values increase.

Furthermore, ownership, such as it is, seldom corresponds to the needs and interests of the owner. Lacking any inducement to invest money in land upon which he pays no tax and to which he has but a vague title, the owner is likely either to ignore his forest altogether or to subject it to the two most wasteful types of exploitation burning them for agricultural clearing and highgrading for specially valuable products. The first destroys the forest and subjects the soil to perhaps irreparable damage, while the second results in a forest that is permanently depleted.

Land has always been plentiful in Bolivia and hence the traditional policy of the Government has been to hand out these large tracts with no serious provision for use, payment, or taxes. Otherwise, it has no land policy whatsoever. Large areas — no one knows how large — are recognized as belonging to the Republic, but only in the sense that no one has established a title to them. They can be acquired in almost unlimited quantities simply by proving that they are public domain and paying a cadastral fee.

Perhaps one reason for this lies in the cultural tradition of the Bolivian people. Neither their Spanish nor their Indian forbears were a forest-dwelling or a wood-using race. They sought the uplands and built of earth and stone. Hunger for wood and skill in its use, so often found in the races of northern Europe, were not part of their make-up, and the same is true of their descendents today.

A people that is unfamiliar with wood is likely to be indifferent to the forest that produces it. Hence the careless and uncontrolled burning of great areas to provide pasture for the half-starved cattle of the Beni. Hence the *chaco* system of shifting cultivation. Hence the lack of any management policy whatsoever with regard to what is left of the people's forest property.

History and Present Status of Forest Industry

Although Bolivia has a history of 400 years of European settlement, wood has only entered significantly into the national economy within the last 50 years. Prior to that it was practically confined to those primary uses which can most easily be made of the trees on hand. Fuelwood and poles were used in quantities, planks and beams were cut by hand, and numerous small articles of daily use were fashioned of wood. This type of artisan industry continues and undoubtedly absorbs a greater volume than the more formal type that has since appeared.

The first product to enter the export market was cinchona bark from the Yungas. The tree from which it comes is rather a delicate one and requires conditions for growth. Plantations have not been successful in Bolivia; and as a result of the of trees, competition from other countries, and synthetic products, the industry has dwindled. There was a spurt of interest in the industry, during World War II, but the gathering of bark from wild cinchona trees will probably go the way of so many other purely extractive industries and eventually disappear.

Tapping wild Hevea trees in the northern provinces has likewise been a precarious but persistent occupation and has kept "Beni" rubber on the international market. It is currently yielding about 2,000 tons (1,814.4 m.t.) a year, though that figure was trebled during World War II.

For several decades the small handicraft industries using wood have been in a state of decline. Local timber supplies have given out while a larger population and a more advanced economy have demanded wood manufactured more precisely and more abundantly, and in forms that the small industries were unable to supply. Hence the rising imports of softwoods from the United States of America and Canada, which in the typical pre-war year of 1938, amounted to 15 million board feet (35,400 m^3.)

Added pressure for wood has come from the mines and railroads which have been expanding steadily. They also turned to foreign sources and sought mine props and ties from Chile and Argentina.

The outbreak of World War II created shortages of these industrial items — shortages which still cannot be met by foreign purchases on account of high prices, depreciation of the national currency, and active markets throughout the world. With five railroads under construction and world metal prices rising, the demand for props and ties is bound to remain high. The market for wood in other forms such as construction lumber, flooring, veneer, furniture, charcoal, and fuel has created such fantastic situations as could scarcely be duplicated elsewhere. Rough lumber is flown to La Paz by airplane from the Beni 500 miles (804.5 km.) away. Charcoal is made under incredible difficulties at Sajama and carried three days by llamas to the railway at Charaña, 150 miles (241.4 km.) from La Paz. At Cochabamba eucalyptus leaves are used for firing bricks.

The result of such demands has been the rapid growth of a lumber industry using native timbers and faced with all the usual difficulties of operating in remote and underpopulated areas. In addition there is a notable lack of proper machinery. Of the seventy-odd establishments that might be termed sawmills, perhaps half-a-dozen are capable of turning out 5,000 board feet (11.8 m^3) a day. Usually their only products are rough boards, although several machines produce flooring and one a satisfactory grade of plywood. Trade standards of grading have not been established and statistics of production are unknown.

An odd assortment of North American, European, and home-made equipment is pressed into service. For lack of boilers, mills are often powered by Diesel oil brought at great expense by truck or airplane. Although men are scarce in the frontier regions where these sawmills are located, lavish use is made of hand labor.

This lumbering is most active in that forest lying just to the east of the Andes, which has been designated

as the richest and most accessible. Reyes, due north of La Paz beyond the last Andean ridge, has six sawmills and an airport for transporting their output. The Yungas have one mill operating. Cochabamba has five mills, and receives lumber by truck from the Chaparé and Santa Cruz areas for reshipment by train to the Altiplano. About 35 mills are in the general vicinity of Santa Cruz. The railways north from Yacuiba and west from Corumba have created demands for ties and fuelwood that are met locally. In addition, Riberalta and Trinidad have become small lumber exporters by airplane.

Problems of Forest Industry

In endeavoring to meet the rising demand for wood products, the lumber industry has had to contend with certain difficulties that are particularly acute in Bolivia.

One of these is a transportation system that was designed to serve the mining interests on the Altiplano. To date not a single first-class road or railway connects the Altiplano with the forest areas. Furthermore, the primary route that will cross the mountain barrier from Cochabamba to Santa Cruz has been laid out to run through a treeless zone and not, as might have been possible, through the heavy forests east of the mountains.

River transportation cannot be looked to for help in supplying domestic need because the rivers of the Beni converge at the northern tip of the country, as far as possible from the national markets. They are also subject to floods and have almost imperceptible gradients. Hence the channels are winding and shallow.

Under these circumstances air transport has been resorted to and has succeeded as a short-term means. It is, however, a vivid indication of how badly Bolivians need lumber, and to what length they will go to get it, rather than attempt an adequate long-term solution.

Further impediments that have an immediate effect are the exchange controls, which operate as a subsidy to the import of lumber, and the internal taxes, which only hamper trade and yield no compensating revenue to the government. There are also various export restrictions.

The need for proper woodworking machinery has become acute. The portable sawmills made in North America are adapted only to certain kinds of woods and log sizes. Even they are difficult to import, and such items as tools and parts are not readily available.

The problem of skilled labor always looms large when forest operations have to be conducted under primitive conditions. In Bolivia this is particularly so because the industry is a new one and the workers are accustomed to their own hand methods. They often refuse to use saws for felling trees and paevies for rolling logs. They also cling to the custom of sawing logs only into 9-foot lengths (2.7 m.). Although operators often complain of the shortage of workers, they show little ingenuity in using those they do have, and very little concern for their safety.

Forest enterprises are so far all on a small scale and hence their needs for credit are not excessive. They are, however, often forced to build expensive roads to reach timber stands. Climatic conditions may force them to log for only a few months and wait the rest of the year with a large inventory. Under these conditions the need for some credit is obvious.

So far the demand for native woods has been highly selective, accepting only a few species and neglecting the others. The reason for this lies partly in custom and partly in the complex nature of the forest. Most of the woods have not been studied and have not yet become established on the market.

A final obstacle relates to the whole problem of land ownership. Although much standing timber is available, the delays and uncertainties of establishing title are a continual threat to long-term and efficient forestry operations.

Problem of Forest Laws

The first decree relating to forest exploitation was issued in 1939. It declared Mt. Sajama to be a national park and prohibited further cutting of keñua. It further required permission to cut or destroy forest trees, proclaimed reforestation to be obligatory, and ordered municipalities to maintain nurseries. The rewards and penalties which were to be enforced by the local authorities were specified in detail. Since that time seven other decrees have appeared which reiterate the same points.

These laws do indicate a laudable concern for the forest resources, but all contain such grave defects that it would be impossible to enforce them, even if the Governement were disposed to try. They lay far too much stress on planting and on the supposed magic of permits. Beyond a rather complicated schedule of fines and rewards no provision is made for carrying them out. To declare that cedrela may not be used for fuel and that reforestation is obligatory throughout the Republic is to be at once too specific and too general, and reveals a lack of study, statistical facts, and field experience.

Forest law is not a subject which can be dealt with in a hasty or sentimental fashion. In Bolivia it attempts to regulate the relations between a biological complex that is very large and not well known, and a people accustomed to use that resource with no restrictions. It is a pioneer people familiar with such purely extractive industries as mining and shifting agriculture. The restraint required to handle a renewable resource will be difficult to instil.

Forest Protection

The problem of forest fire is not the same in all parts of the country. The Yungas, for example, are of great importance not only on account of the timbers which they can produce but even more because they are the headwaters of streams which cross what is potentially the most productive land in Bolivia. Unfortunately the type of very ancient shifting agriculture that has taken root here is of low productivity and great destructive power. Woodlands are felled, burned, and cultivated for a dozen or so years before they are allowed to revert to brush and, eventually, trees. The fires that are set to clear off a particular tract often spread beyond

the limits, damaging brush and grasslands though they probably do little harm to the woods, which are too dense and moist to burn. The population of the Yungas is still sparse and tree growth is luxuriant. Barren, eroded slopes are, therefore, as yet not common. They do exist, however, as an ugly reminder of what has happened in other Latin-American countries that have had the same problem and neglected it. Floods, silting and poverty are the inevitable results.

In north-central Bolivia there is a very large area that is too dry and too poorly drained to support forest growth. This section, known as the llanos, is a grazing country. Great herds of half-wild cattle roam over it in search of water in the dry season and the coarse native grasses at other times. It is the almost universal custom of ranchers to burn the range in order to stimulate the growth of the young pasture. Quite probably the perimeter of the forest is being pushed back by these fires. As the ground cover is burned off and the soil is exposed to direct sunlight, it becomes drier and more prone to burn when the next fire occurs. Young saplings are killed and the tree type gradually gives way to thorny brush and coarse grasses.

The most acute forest fire problem occurs in eastern Bolivia where the natural cover is a low inflammable forest and where the dry season lasts throughout the months of June, July and August. A desultory cattle industry contributes to the problem as it does to that further north, and for the same reasons.

It is made more acute by roving bands of Indians who do not follow roads and who find travel more convenient through woodland that has been burned. Their activities are particularly difficult to control because they are completely outside the law.

The problem has further been intensified by the wood-burning railway which now operates between Corumba and San José, and which is being extended to Santa Cruz. Following a well-known and predictable pattern, the incidence of fires has increased precisely where a demand for fuelwood and ties has been created. The soils of this region are subjected to progressive and irreparable damage as the humus is destroyed and exposed to wind and water erosion. A railway and a desert are being created at the same time.

The question of overcutting likewise varies and depends upon the region involved. Reference has already been made to the continued destruction of the keñua around Mt. Sajama, where a unique forest type of great botanical interest is being destroyed for a small amount of charcoal.

In the valleys to the southeast of the Altiplano, the comparatively heavy rural population is interested principally in hillside farming and grazing; trees are considered only as a source of fuel. As a result, both the forest and the land have reached a state of utter degradation unparalleled even in Bolivia. What exists here is not an acute problem of overcutting, but the results of a problem that was acute two hundred years ago.

The rain forests of northern Bolivia are endowed with mahogany, one of the world's most valuable [illegible]. The irresistible temptation, especially in a country with difficult transport problems, is to cut only the mahogany and to use it for purposes which could be met with other woods. The proportion of mahogany in the forest thus steadily decreases. Inferior species take its place and a permanent deterioration results. Almost every forest type has experienced the same kind of selective cutting or high-grading in the early stages of exploitation. The tragedy is not that the mahogany is being cut — for it should be used as wisely as other resources — but that so little of its value is realized that it is used for pig pens and cart wheels. Such waste is a symptom of an underdeveloped forest economy.

The abovementioned railway east from Corumba towards Santa Cruz is creating other problems besides that of fire. At present they are predictions rather than actualities, but the example of other countries is so notorious that they should not be neglected.

The locomotives on this line burn wood. While there is nothing inherently objectionable in this fact, the enormous quantities of wood needed to operate a railway cannot be permanently secured from an open, slowgrowing forest type unless special care is taken. In less time than anyone imagines when looking at the seemingly interminable stretches of forest, it will recede to uneconomic distances. Each year fuel will be supplied with greater difficulty and ultimately it will be imperative either to maintain plantations or find another fuel that need not be renewed.

The same danger exists with regard to the deposits of iron ore whose development is planned for the region about Matun, just south of the railway on the Brazilian frontier. Bolivia has no coal deposits and the assumption is that charcoal will be used to smelt the ore. The pattern of overcutting, neglect, and wood famine is again too notorious to be overlooked.

The foregoing discussion adds up to the plain fact that a forward-looking policy is required for supplying the needs of Bolivia's people and for protecting them from the horrors of forest devastation and wood famine. Trees can supply the wood that they so desperately need. Forests can protect the soils, the streams, the wildlife, and the beauty of their mountains. Forests can help to build the houses, to support the railroads and mines, to provide the exports upon which the living of the Bolivian people depends.

Private industry has shown the initiative to expand and operate against odds that would be considered insuperable in many other countries. It needs official help, however, in exploiting one of the finest forests left intact in the world; and guidance to make sure that this forest will be used wisely and permanently for the benefit of all Bolivians, both those of today and those to come.

Progress of Research Activities in South Africa

By the Director of Forestry, Union of South Africa

RESEARCH into timber seasoning and preservative problems in the Union of South Africa was begun on a very small scale in 1919 by the newly created Timber Investigation Section of the Department of Forestry. The results of this work were so encouraging that in 1926 it was decided to establish a central, self-contained, experimental station. What is now known as the Forest Products Institute came into being in 1928; it is a branch of the Department of Forestry, with the Chief Forest Products Officer in charge of the Institute responsible to the Director of Forestry.

The Institute is perhaps unique in that its original activities included a considerable amount of marketing research and development, with the object of proving the value of local products when correctly handled or designed for large-scale distribution. This policy was well justified, since it had the effect of emphasizing the practical aspect of research and, because of the large volume of products handled, contributed considerable useful experience.

During the last 10 years the functions of the Institute have been purely of an experimental nature; they may be described briefly as research into all problems connected with the conversion, treatment, and utilization of locally grown timbers (indigenous and exotic). Equipment consists of a sawmill, planing mill, and five different types of commercial kilns, to deal with sawing and drying problems and with the evaluation of the physical and working properties of timber; open and pressure tanks to investigate the various methods of impregnating the numerous timbers with preservatives; numerous testing machines to determine the mechanical properties of squared timber and poles; and facilities for the grading and identification of timber. There is also a chemical laboratory and a large and unique wood museum.

As the Forest Products Institute is the only one of its kind in the African Continent it renders assistance to public and private concerns throughout Africa as well as to local government and private bodies. Courses in kiln seasoning and other subjects are held from time to time. Close contact is maintained with many overseas laboratories of the same type, and reports and publications on the results of the work are interchanged.

Timber Preservation

The State's afforestation of large areas in the Union with exotic softwoods and hardwoods introduced the problem of utilizing the thinnings of young non-durable poles. This problem was partly solved by working out appropriate impregnation schedules and preservative solutions for a wide range of products, including fencing and building poles. The introduction of chemically treated eucalypt telephone and electric transmission-line poles has been particularly useful, since it has enabled scores of small municipalities, which could not have afforded the price of steel poles, to install electric power.

More recently, to combat the activities of the European house borer (*Hylotrupes bajulus*) and the West Indian dry wood termite (*Cryptotermes brevis*), appropriate preservatives were found and methods of application drawn up for imported woods as well as local timbers.

In this connection, the Institute's development of a non-oily, quick-drying, and non-blooming type of pentachlorophenol preservative has had important significance. This preservative, which has high penetrating properties, is used in the form of a soaking treatment for many pine species, and with very low pressures (5 to 20 lb.) for hardwoods.

Sludging, which occurs in some oil creosote mixtures when used as wood preservatives, has been almost entirely eliminated in some cases by the use of an aromatic "bridging agent" or by the use of oil containing highly aromatic properties. This discovery facilitates penetration and enables the use of creosote mixtures with oil, re-inforced with pentachlorophenol, copper naphthenate, or other suitable chemicals.

An evaluation of the preservative properties of some eighty different wood preservatives has been obtained from tests carried out over a number of years. The tests consist not only of observations from actual service throughout the country but also of scientifically planned experiments, based on modern techniques, located in areas where decay hazards as well as combined decay and termite hazards are severe. In all cases the protection offered by the oil preservatives has been found to be far superior to that offered by any water-borne salts for outside work.

Work is continuing along these lines in an attempt to extend the use of the available quantities of creosote, which is limited, by appropriate mixtures. Close attention is being given to the use of fish oils in place of dehydrated castor oil in pentachlorophenol solutions; and the termite and decay tests will be extended to include ship-worm and other destructive marine agencies.

Timber Seasoning

From study of the developments in kiln design throughout the world, the Institute has been successful in developing a kiln which combines all recent improvements. This kiln, in addition to the four other types of kilns, has been in operation for the last three years. The design has been widely adopted by the timber trade and has undoubtedly resulted in increased efficiency

in seasoning generally. It includes overhead reversible cross-shaft fans and is suitable for the precise drying of both hard- and softwood timbers.

Kiln seasoning courses held from time to time have been attended by persons resident in the Union, as well as by others resident in adjacent territories. Schedules for most of the important local timbers have been determined, and a standard work on timber seasoning in South Africa has been published in bulletin form.

The Institute has determined the equilibrium moisture content of various timbers in most of the important cities in the Union, and has collected data on the shrinkage and seasoning properties of many woods. A special study of the seasoning of young eucalypt timbers has brought about a reduction in the very high wastage usually associated with their use. Frame saws and double log-edgers, introduced to deal with the stresses found in these timbers, have proven very successful.

Uneven rate of growth in coniferous timber has not been found to be the cause of excessive warping in any of the species examined when cut to the normal building sizes of $1^1/_2'' \times 4^1/_2''$, $1^1/_2'' \times 6''$, and $1^1/_2'' \times 9''$. Sections of $2'' \times 3''$ from the center of the stem occasionally show stress, but spiral grain and compression wood are of greater significance in producing warp.

Investigations are now being made of the extent to which the spiral markings, visible on the bark of *Pinus longifolia* trees, serve as a guide to judging the degree of twist likely to be found in boards sawn from those trees. Spiral grain in *P. longifolia* appears to have little if anything to do with rate of growth, but is traceable to seed stock. Other stresses in seasoned boards are also being examined to determine the cause of warp, especially in young coniferous timber.

Timber Utilization

Additional and better uses have been found for a number of the indigenous timbers which, owing to the small volume available, should be used to the best advantage. White pear, for example, is admirably suited to printers' cutting sticks; yellow-wood is excellent for battery separators, and Cape ebony is suitable for slide rules.

Such imported species as *P. patula* and *P. radiata*, which are now widely planted, have undergone considerable research. Little information could be obtained from outside the country, but the timber from these and numerous other introduced species has now been examined, and a study has been made of the effect of age, rate of growth, and variations which occur within a plantation or a single tree. Some of the generally accepted overseas conceptions have been found inapplicable to these young exotics. For instance, it has been established that the age of the tree and not the rate of growth influences the wood qualities. In other words, fast rate of growth does not produce light, soft timber unless it has taken place at a very early stage (1 to 10 years) of the tree's growth; in any event, after about ten years, regardless of how fast the trees have been grown, the timber is amply strong for all normal building purposes.

Draft grading rules for local coniferous timber, based on the results of examining many thousands of cubic feet during the course of the experiments, have been prepared by the Institute and, with the co-operation of the Lumber Millers' Association and the South African Bureau of Standards, have also been published for general use.

Early research into the use of wattle, gum, and pine for pulp and paper-making have helped to promote industries which are now well established.

In addition to examining the locally produced timbers, the Institute has prepared and published notes on the properties and uses of a great many hardwoods from adjacent territories. It will continue to work along the lines indicated, and plans to concentrate particularly on research into the production of shingles, diving boards, and sleepers from locally grown timbers.

Timber Mechanics

The Institute works in close co-operation with other laboratories to secure the highest degree of conformity in all routine and other mechanical testing procedures.

From tests of locally grown pine timbers, it has been found that density and strength follow a definite pattern in which there is an increase in strength from the center of the stem outwards, culminating in some instances at about the thirty-fifth year, i.e., when the trees are almost mature or have reached a diameter of about 18 inches, breast height under bark. There is also a decrease in the strength from the base upwards.

No correlation has been found between ring width and strength, other factors being equal, but a distinct correlation between age and unit strength has been observed.

It should be noted that while these facts have been found to hold true for pines, they are not equally applicable to such species as *Cryptomeria japonica* and some other conifers.

For the testing of transmission poles, special equipment has been installed by which transmission poles up to 48 feet long and 8-inch top diameter can be readily tested for strength. It is largely owing to the results of these tests that the Electric Supply Commission was willing to utilize local wooden poles throughout the country.

Work will continue on determining the factors influencing strength in pine stems; the next species to be investigated will be *P. pseudostrobus* and *P. longifolia*. In the latter case the effect of spiral grain on strength will also be determined.

Silvicultural Research

Investigations into Thinning Techniques

Research in the thinning of pure, even-aged coniferous stands, based on O'Connor's method, is being carried out.[1] The basis of this method is that the investigation should not be confined to practical degrees of thinning intensity, but should range by steps from the extreme of complete suppression (in which state the stand can carry no greater number of trees at a given age) to that of free growth (in which state dia-

[1] A. J. O'Connor, *Forest Research with Special Reference to Planting Distances and Thinning*, Government Printer, Pretoria, 1935.

meter growth cannot be stimulated by further reduction in stocking at a given age). The object is to produce a series of correlated curves, from which the experiment takes its name of Correlated Curve Trend or C.C.T. method, expressing the relationship between volume of the mean tree to density of stocking at set intervals throughout the rotation. At the same time other plots are being maintained with the object of estimating the degree of response to various degrees of thinning at various degrees of suppression and at various ages. The degrees of response and suppression are expressed on a relative basis incorporating the degree of thinning, thus reducing the variables to proportions that can be handled on three-variable graphs. The information shown on the graphs is to be applied to the correlated curves to determine the effect of any degree of thinning at any stage, due allowance having been made for the mechanical effect of thinning on the mean D.B.H. of the stand.

Experiments of this nature are being conducted for all the main exotic conifers (i.e., *Pinus patula*, *P. radiata*, *P. taeda*, *P. caribaea*, *P. pinaster* and *P. roxburghii*) on all types of site on which they are of commercial importance. The oldest experiments have now been in progress for 12 years and show the following preliminary results :

1. Neither species nor site quality markedly influences the age at which mutual competition between the components of a stand of given density commences.

2. Mutual competition between the components of stand commences in 1,200 trees per acre in the fourth year, in 600 trees per acre in the fifth year, in 400 trees per acre in the sixth year, in 300 trees per acre in the seventh year, in 200 trees per acre in the eighth year, in 150 trees per acre in the ninth year, and in 100 trees per acre in the tenth year.

3. A stand when thinned will tend to assume the same rate of growth (volume increment) as the rate that is normal (on the same site quality and at the same age) for the density to which it has been reduced by the thinning. The relevant data is still somewhat meager, but it appears that this statement holds good for all stands up to the twentieth year, irrespective of the degree of suppression in operation prior to thinning or of the intensity of the thinning. Expressed in O'Connor's terminology, it may be said that the coefficient of response is unity for all coefficients of suppression.

4. The response to thinning takes 6-10 years to find full expression. The current annual increment of the thinned stand gradually increases and equals that of a stand at the density to which it has been thinned after 3-5 years. Thereafter it surpasses the increment of such a stand and falls again to equal it at 6-10 years, remaining level with it thereafter. The periodic mean annual increment of the two stands is the same over the full period of 6-10 years.

Pruning Investigations

Pruning in South Africa is based on the conclusion that the knotty core must be restricted to a diameter of 4 inches. The effects of removing live branches, necessitated by such a restriction, have been closely studied.

Experiments on pines show the following results :

1. The effects of pruning are more marked and more lasting when selected stems only are pruned than when all the trees in the stand are pruned.

2. Live pruning retards diameter increment more than height increment.

3. Pruning 25 percent of the living crown has no significant effect on either diameter or height increment.

4. Pruning 50 percent of the living crown has a significant effect on diameter increment but not on height increment.

5. Pruning 75 percent of the living crown affects both diameter and height increment to a significant extent.

6. Recovery of normal increment after 75 percent of the living crown has been pruned takes 2 years if all the trees in the stand are pruned and 3-5 years if selected stems only are pruned.

7. Between the ages of 4 and 8 years the effect of selective live pruning on growth is inversely proportional to the age at which pruning takes place, the older stands being less severely affected.

8. The ability to withstand severe selective live pruning varies inversely with the site quality, the depression of increment being least and the rate of recovery greatest on poor sites.

9. The taper of the stem is decreased in the region 10 feet above and 10 feet below the lowest whorl of branches.

10. The mean branch diameter of the remaining branches is not increased by live pruning.

The present practice in South Africa is to prune to a height of 22 feet. Further experiments are being undertaken to determine whether it is economical to prune to greater heights.

Genetic Research

Research of this nature is still in its initial stages. Efforts are being made to improve the form and rate of growth of the main coniferous species by the collection of seed from elite trees and by controlled pollination. In addition, the possibilities of producing useful hybrids are being examined.

An investigation into spiral grain in *Pinus roxburghii* (Syn. *P. longifolia*) has confirmed conclusions that the main factors concerned in the production of spiral grain are hereditary. Steps are being taken, therefore, to establish future sources of seed in suitably isolated stands from which all excessively twisted stems have been removed.

Statistics

Stem volume alignment charts and percentage utilization tables have already been produced for the main coniferous species. Similar tables are in the course of production for the main eucalypt species. Statistical plots are also maintained for all exotic species of commercial importance not covered by the C.C.T. method.

Forest Hydrological Research

In view of the importance of the forest lands owned by the Union Department of Forestry for Water Conservation, comprehensive research to determine the effects of afforestation and other forms of vel[illegible] manage-ment on water resources has been undertak[illegible]

Two research stations have been established, one at Jonkershoek, in the winter rainfall region, about 35 miles from Cape Town and 6 miles from Stellenbosch and one at Cathedral Peak, in the summer-rainfall region, about 26 miles from Winterton in the Bergville district of Natal. The investigations at these centers are analytical and experimental, and some of the results obtained have already been described in *Unasylva*.[2]

[2] Vol. IV, No. 1 (January-March 1950, p. 46).

Forest Fire Danger Measurement in the United States

By A.W. Lindenmuth, Jr., and Ralph M. Nelson
Division of Fire Research,
U.S. Forest Service, Southeastern Forest Experiment Station, Asheville, N.C.

In the United States an average of more than 182,000 fires burn every year, almost 300 fires per million acres (404,690 ha.). Almost two-thirds of these fires, a concentration of about 700 per million acres (1,730 per million ha.), occur in the South, the region expected some day to produce half of the nation's total timber supply, while the Pacific Northwest states of Oregon and Washington, where almost 40 percent of the country's present saw timber is standing, only 3,815 fires burn annually.

Fires range in intensity from innocuous and easily suppressed ground fires to holocausts that defy control. As examples of the latter type, the Miramichi fire of 1825 in Maine and New Brunswick is believed to have swept through 3 million acres (1,214,100 ha.) and taken the lives of 160 people. The Peshtigo fire of 1871 in Wisconsin burned more than a million acres and caused the death of 1,500 people. In 1933, the Tillamook fire raged through one of Oregon's finest timber stands killing 10,000 million board feet (45,300,000 m^3) of timber, only 4,000 million feet (18,120,000 m^3) less than the total U. S. lumber cut for that year. More recently, in 1947, fires burned 240,000 acres (97,128 ha.) in Maine, 800 homes were destroyed, and countless people suffered untold hardship. Fortunately, such fires occur infrequently, but the fact that they can occur emphasizes the need for well-trained and organized protection forces.

Because of the danger, foresters, land managers, landowners, and others charged with the administration or protection of forest lands have for many years been seriously concerned with the control of fires either by prevention or by prompt suppression.

This concern has added great impetus to the study and development of techniques and equipment for controlling fires. The fact that the average size of fire has been reduced from 100 acres (40.47 ha.) (5-year average, 1926-1930) to 37 acres (14.97 ha.) (5-year average, 1945-1949), and that five times as many fires per million acres (404,700 ha.) burn on lands not under organized protection as on lands protected by public and private agencies, is proof of the worth of well-developed techniques. No small part of these gains, in all sections of the country, have been accomplished through the use of fire danger measurement systems. As a basis for these systems, stations are located in the forests at strategic points, where fuel moisture, wind velocity, rainfall, and other variables affecting burning conditions are measured with instruments. The knowledge obtained from daily measurement of variable factors directly affecting the flammability of forest fuels, collectively called fire danger, at hundreds of fire danger stations — 300 in the South alone — has been of great value in holding fires to a small size, and to some degree in preventing man-caused fires.

Early Research in Fire Danger Measurement

Early fire fighters undoubtedly were aware that under certain conditions of fuel and weather fires burn with greater or lesser speeds and severity. Rules of thumb, such as estimating wind velocity from the movement of trees or smoke drift, and fuel moisture by the extent to which pine needles would bend without breaking, or the ease with which hardwood leaves would crush in the hand, were useful to an experienced man in

an area familiar to him. However, he could not use them with any precision to judge the wide range of conditions that existed between the times when forests were safe from fire or highly flammable.

Recognizing the need for better methods of measuring fire danger, H.T. Gisborne of the Northern Rocky Mountain Forest and Range Experiment Station in the early 1920's began a study of the variables that influence the severity of burning conditions. He found four highly significant factors: (1) season of the year — whether the flammable vegetation was green, in a transition stage, or cured; (2) fuel moisture of heavier fuels as measured by one-half inch sticks; (3) relative humidity, which was a measure of the flammability of finer fluels; and (4) wind velocity. He integrated these variables in a slide rule type of danger meter which for the first time enabled a fire-control officer to obtain a numerical index of fire danger. Burning conditions could at last be precisely defined. The device proved so useful that other Experiment Stations developed systems of fire danger measurement to fit conditions peculiar to their regions.

Regional Differences

Differences in forest types, fuels, climate, and topography, in the principal forest regions in the United States have given rise to variations in methods of measuring danger. The character, arrangement, and volume of fuels; the periodicity and amount of rainfall, wind velocities, and temperature; the aspect and elevation, are only some of the factors that had to be taken into account.

From the Rocky Mountains westward, precipitation averages 10 to 20 inches (25.4 to 50.8 cm.), most of which falls in the winter. The forests are coniferous and the fuels are chiefly deep duff, or heavy slash following cutting. Because of arid summers and heavy fuels, the cumulative effects of drought are very significant in rating fire danger. The moisture content of the fuels decreases progressively during extended dry periods and for that reason one-half inch sticks, which do not dry rapidly, are used as a measure of moisture content.

In the other principal forest area, the East, which extends from a few hundred miles west of the Mississippi River — excluding the mid-continental plains area that supports no important forests — to the Atlantic Ocean and the Gulf of Mexico, rainfall from 40 to 60 inches (1,016 to 1,524 mm.) is fairly evenly distributed during all seasons. Prolonged drought periods are relatively infrequent. The forests are a mixture of deciduous and coniferous types. The fuels are generally grasses in the long-leaf pine type of the South, pine needles in the loblolly type of the Southeast, hardwood leaves in the deciduous forests in the mountain types, and spruce and fir duff in the far North. Because of the plentiful rainfall, fires burn chiefly in surface fuels. Therefore, daily variation in the moisture content of the dried grasses or the topmost layer of coniferous or hardwood leaves is the important element of fire danger. One-eighth inch (0.3175 cm.) basswood slats are used to measure the moisture content of these fuels in the Northeast and South; relative humidity is used as an indicator in some parts of the East.

As continuing research permitted a clearer identification of the regional variables that contribute to fire danger, and as fire control officials became more familiar with the many uses of danger measurement, danger meters for integrating the variables were modified from time to time. Instead of being graduated in a few broad classes, as at first, most types now express danger on a scale of zero, or one, to a maximum of 100 units. The highest and lowest points are not standardized, however, and intervening gradations vary among different types. As examples, in the Northern Rocky Mountain sections, the minimum rating of one indicates conditions under which fires will probably not increase in size; a rating of 100 means that small fires are likely to become unmanageable. In parts of the East the lower 50 gradations of the 100-point scale are divided into 6 classes proportional to the ease with which fires will ignite. The upper half of the scale constitutes a single class which represents explosive conditions

Uses of Fire Danger Measurement

It is possible to correlate danger ratings with a number of fire phenomena such as rate of spread, behavior, occurrence, or damage, provided the local climate is well sampled with weather measuring stations, equipped with accurately calibrated instruments, and operated by competent observers. The number of stations and their location, as well as the elements measured, depend mainly upon the diversity of the climate and the use to be made of the data.

In the West, where terrain and fuels are ordinarily more difficult than in the East, several elements of fire danger are incorporated in an index to judge the number of men who should be dispatched to a going fire. For example, in California a meter has been devised which integrates fuel type, percent of slope, wind velocity, and fuel moisture, and which correlates these variables with a rate-of-fire-spread factor. This in turn can be converted into figures which indicate the number of men required to construct fire lines under given conditions.

In the northern Rocky Mountains, where danger ratings are correlated with fire behavior and where cumulative drying of fuels during the summer is a prime factor of fire danger, ratings are a valuable guide in placing men on active duty in the many fire-control positions. This western country is a land of rugged mountains, and vast areas are very remote. Hence it is impossible to expand or reduce the number of men employed each day as in the East. During the winter, spring, and fall, when the fuels are covered with snow or are wetted as it melts, the average danger rating is about zero and very few of the fire organisation positions are filled. But as the average fire danger increases in the late spring, when the rating ranges from 20 to 30 for several days, then 30 to 40, and so on, more and more men are hired until all men needed to handle the normal amount of fire suppression work are employed. While employed, these men are not necessarily working at all times on fire-control activities. At intervals, showers or cloudy weather may lower the danger rating temporarily, and during such periods men are shifted from fire-control positions to such jobs as repairing equipment, telephone lines, and similar work.

They are still available, however, to assume their fire-control duties whenever needed.

Danger ratings have been correlated with the relative probability of fires igniting in the pop lo s Northeast, where 99 percent of the fires are caused by people; thus the scale on the danger meter is graduated accordingly. It has been found that the probability of fires starting depends primarily upon the number of people in the forest and the care with which they handle or discard igneous materials, extinguish campfires, burn debris, or otherwise employ materials capable of igniting forest fuels. Ordinarily the number of residents or visitors in the forest remains fairly constant over long periods. Their habits also remain about the same unless rather drastic action is taken to change them

That close correlation can exist between accurate danger ratings and fire occurrence is indicated by an analysis of records from a section where the number of people and their habits are fairly stable. The area sampled, comprising some 2,300,000 acres (930.810 ha.), is part of an eastern state. More than 3,000 fires that burned during the three year period, 1947-1949, were compared with average danger ratings — as obtained from seven danger stations distributed throughout the area — for all days during the period. The correlation coefficient was 0.94, which means that 88.4 percent of the average daily variation in the number of fires was accounted for by variations in fire danger.

Thus, in the Northeast the meter can be used with considerable confidence in predicting the number of fires that will ignite from day to day. From forecasts made 24 hours in advance by the United States Weather Bureau, estimates of fuel moisture, wind velocity, precipitation, and temperature, are obtained and the expected fire danger calculated. The fire control administrator, knowing the fire danger and expected number of fires, determines whether he should post observers to detect the ignition of fires, how many men he should hire to be ready to suppress fires, and the number of pieces and type of equipment probably needed during the period. This provides a basis for many other important decisions essential to adequate fire control planning. If the estimate of the number of fires is considerable, the public can be warned by radio and through the newspapers.

If daily ratings of relative flammability are available it follows that seasons or years for a particular field unit, or between units, can be compared. In the Northeast this is done by summing the daily ratings and determining the relation between the ratings and numbers of fires. Because daily ratings are proportional to the expected number of fires, the same relationship will hold for longer periods. The ratio of one variable to the other can be used as a measure of variations in flammability. A comparison of actual versus expected fires can also be used to measure the effectiveness of fire-prevention measures. This is possible because over large units the number of forest users remains relatively constant. Thus, the number of fires is affected chiefly by the care with which users handle or use fire (one of the elements of risk) and by flammability (as measured by danger ratings). A graph of the ratio of expected to actual fires by time establishes whether fires are on the increase or decrease and thus provides a gauge for the effectiveness of prevention activities.

From this type of comparison it has been determined that the number of fires per unit of fire d[illegible] has been reduced about 21 percent in the Nort[illegible] region during the past five years. In several st[illegible] reduction has been highly significant. Inasmuch the population of the region has not decreased, the smaller number of fires can only be accounted for by good prevention programs. Strict enforcement of debris-burning permit laws, and the issuance of warnings during critical periods, both based on the estimated danger, are the measures which are believed to have brought the best results.

The summing of units of burning index for successive days or weeks can be a useful indicator of impending critical situations. This is illustrated by an analysis of the burning conditions which prevailed prior to the period October 21-25 in 1947, when fires caused tremendous damage in Maine. A comparison of records for July, August, and September of 1947, with averages for the years 1943-1946, reveals nothing that might have given fire officials concern. However, by cumulating units of burning indexes by 5-day periods beginning September 1, as is done in the following table, it is readily apparent that early in October there were signs of increasing danger.

Date	*Units 1947*	*Units 1943-1946*
September 20	80	80
September 25	100	110
September 30	160	135
October 5	200	160
October 10	350	190
October 15	555	220
October 20	800	240
October 25	1140	270
October 31	1350	300

The sharp increase in burning index units during the period October 5-15, had the information been available, should have alerted all fire-control agencies and the public. By October 20 it would have been clear that conditions were extremely critical. Methods now in use will detect the build-up of any similar critical period.

In the South, where it has been found that variations in danger account for more than half of the variations in average rate of spread, the chief use of danger ratings is to guide fire-control action. When fast rates of spread are indicated, more observers are used to speed the discovery of fires, larger crews are dispatched rapidly to all fires, mechanical fire-line builders are utilized fully, and such other action taken as will aid in holding fires to a small size.

Besides their direct uses as guides and measures, danger ratings are sometimes treated as a single factor among several that are integrated in order to arrive at other indexes. For example, danger ratings are one of the factors recognized in the East when appraising fire damage. It has been determined that the number of trees killed or injured by fire by specific timber type, stand density, and tree sizes, is closely associated with the danger ratings.

Perhaps it should have been emphasized earlier that

no mechanical device such as a danger meter can be a substitute for sound judgment in fire control. There are so many variables that influence fire behavior that there can be no fixed rules as to how a fire may be controlled. A knowledge of what is likely to occur in certain degrees of danger can, however, avert catastrophes. Also, during critical periods when it becomes necessary to place responsibility on less-experienced men, a fire plan, based on the degree of danger estimated, can be a very valuable aid. Fighting forest fires requires good men armed with good tools. Fire danger measurement is one of these tools.

HENRY SOLON GRAVES, 1871-1951

Henry S. Graves, forester and educator, died in Brattleboro, Vermont, U. S. A. on 7 March 1951, following a heart attack. As Chairman of the Technical Committee on Forestry and Primary Products of the United Nations Interim Commission on Food and Agriculture, Mr. Graves, by his vigorous personality, objective judgment, and genial nature, gave inspiring leadership to the world's foresters who had the task of formulating the program and organization of FAO's Forestry Division.

He was born in Marietta, Ohio, on 3 May 1871, and was educated at Phillips Academy, where his father was professor of Physics and Chemistry; he took his A. B. degree at Yale College in 1892. At the urging of Gifford Pinchot, the first American professional forester, he studied at Harvard University and at the University of Munich.

In 1898 Mr. Graves was appointed as Assistant Chief and Superintendent of Working Plans in Mr. Pinchot's Division of Forestry in the U. S. Department of Agriculture. His work on research, public education, and co-operation with private forest owners, was handicapped by the lack of professionally trained foresters. As a result, Mr. Pinchot's father, James W. Pinchot, and his family, endowed the Yale Forest School, and in 1900 M. Graves was chosen to organize the School and to serve as its Director.

In 1910 Mr. Graves succeeded Mr. Pinchot as Chief Forester of the U. S. Forest Service and served in this position for 10 years.

Commissioned a Major in the Corps of Army Engineers in June 1917, and advanced to Lt. Colonel in two months, he organized the regiment of forest engineers to cut timber in France for the American armies.

In 1922 Mr. Graves returned to Yale School of Forestry as Dean and was appointed as Sterling Professor of Forestry. For a period of 4 years he also held the post of Provost of the University, and served as Chairman of the University Educational Planning Committee.

Henry S. Graves

In 1939, after he had retired from active duty at Yale, he became Chairman of the Joint Committee on Forestry of the National Research Council and the Society of American Foresters, to study postwar problems in forestry.

He played an important part in the formulation of a number of the late President Franklin Roosevelt's conservation projects. Not the least of these was the Civilian Conservation Corps.

He wrote some 170 articles and bulletins as well as two of the earliest American textbooks in forestry — *Forest Mensuration* and *Principles of Handling Woodlands* and was the co-author with C. H. Guise, of *Forest Education*.

Mr. Graves was awarded a number of honorary degrees, including M. A. from Harvard University in 1911, L. L. D. from Lincoln Memorial University in 1922, from Syracuse University in 1923, and from Yale University in 1939. He was awarded the Sir William Schlich Memorial Medal in 1944, for distinguished service to American Forestry. The French Government in 1947 awarded him the rank of Officier du Mérite Agricole in recognition of his services to forestry. The first award of the Gifford Pinchot Medal was made to Mr. Graves in December 1950.

His broad vision and high objectives are well expressed in the 1945 Report of the Technical Committee on Forestry and Primary Forest Products to the United Nations Interim Commission on Food and Agriculture:

"The basic objectives of a world forest policy should be:

(1) The adequate consumption of forest products to improve housing, clothing and living standards in all parts of the world.

(2) The managed use of the world's forests and forest soils for the continuous production of raw materials.

(3) The conservation of all forests performing social or protective functions.

"In due course, governments may wish to consider a formal declaration that recognizes the achievement of these basic objectives as a duty to their peoples, to each other, and to the world."

To be sure there would be no misunderstanding, his report lists six "specific goals":

(1) Application of efficient silviculture and management to all forests in use.

(2) Afforestation on denuded lands, with particular regard to Asia.

(3) Maintenance of protection forests and their extension to meet the requirement of different areas.

(4) Development of unexploited forests.

(5) Promoting of integrated, modern forest industries.

(6) Balanced expansion of processing facilities for various primary forest products, of forests.

"The achieving of these goals should be accompanied by progressively better incomes and living conditions of forest workers, operators, and owners. Simultaneously, a relative reduction in the cost of forest products should become possible and facilitate their efficient and economical distribution."

Commodity Reports

Wood Pulp

The figures shown in the text are taken from official sources where available, from World Wood Pulp Data *[illegible] by the Canadian Pulp and Paper Association and the United States Pulp Producers Association, and from [illegible] journals. Official statistics generally covered no more than ten months of 1950 and the data for the remaining months were estimated. Unless otherwise indicated, metric units are used throughout. A previous report on Wood Pulp may be found in* Unasylva. *Vol. IV, No. 2.*

THE period following the beginning of hostilities in Korea saw a distinct change in the wood pulp and pulp products picture. Consumption of pulp products increased in the United States of America, but production reached such levels that many analysts, both in government and industry, agreed that consumption was lagging behind and that stocks must be increasing. In Europe the consumption of pulp products increased which may be partly regarded as further evidence of economic recovery. Even so it is not likely that present consumption levels, when calculated on a per caput basis, have yet attained prewar levels. The demand for wood pulp increased in other parts of the world, as a result of the greater use of pulp products and the attempt to secure supplies during a period of rising prices.

During 1950 most countries restricted imports from dollar areas and, as a consequence, reduced their purchases from North America. Supplies from Northern Europe, however, will not be able to meet the current demand, and some importing countries may again attempt to turn to North America for pulp and pulp products. In view of the present tight supply situation in pulp and pulp products moving in international trade, it has been deemed advisable in a number of quarters to consider the possibility of some sort of international allocation. The International Materials Conference has been considering the matter in Washington.

Among the pulp products in demand, the need for newsprint appears particularly pressing. Publishers are concerned about their paper supplies, pointing to the increased need for an understanding by all peoples of the pressing international problems as additional justification of the importance of their requirements. Increases in costs of newsprint have generally been passed on to the public.

In 1950 both Sweden and Finland increased their exports to the United States by more than 60 percent over 1949 levels and thus re-entered this market on a larger scale. However their prices are higher than North American prices. If price controls are put into effect in the United States, these countries may not find the United States market as attractive as at present. In Sweden there was a rush to export as much pulp as possible before 1 January 1951, the date when the "price equalization charges" were to take effect.

There were many large increases in pulp prices and the end was not in sight in the middle of 1951. From the point of view of the producer this is not entirely satisfactory as the increase in demand and in prices might be a sign of world-wide inflationary tendencies. Prices in some spot sales have been getting out of hand.

It is of interest to compare estimates of actual production in 1949 with the forecasts made at the Preparatory Conference on World Pulp Problems held in Montreal in April/May 1949:

Table 1. — World Pulp Production in 1949 and 1950

	1949		1950	
	Actual production	Montreal Conference forecast	Actual production	Montreal Conference forecast
	(*Thousand metric tons*)			
North America	17 888	18 995	20 640	20 310
Europe	8 086	8 900	8 420	9 600
Others	848	1 125	1 066	1 260
Total	26 822	29 020	30 126	31 170

The forecasts made at the Montreal Conference appear to have been remarkably accurate. However, the report of that Conference clearly states that for future years, forecasts were based on "normal conditions." Conditions have in fact turned out far from "normal."

The Korean incident has resulted in such an increase in economic activity and expenditures as of necessity to create a larger demand for pulp products. There was already strong evidence all over the world that the normal demand for such products was growing, making it feasible to increase manufacturing capacity or to establish factories where none previously existed. Plans for the erection of new factories were far advanced in some quarters and in others the necessary preliminary investigations were in process. The greater wood pulp and pulp products requirements resulting from the present international situation will probably further stimulate production, as no country wishes to see any fall in its standard of living. At the Montreal Conference it was anticipated that between 1949 and 1955, under favorable conditions, world wood pulp requirements could increase by as much as 30 percent and world wood pulp production by 27 percent.

Production

The available data indicate that in 1950 there was an increase over 1949 in wood pulp production in most major producing countries. Production in Europe appears to have increased about 10 percent over 1949 levels, in Canada and the United States together about 15 percent, and in Latin America about 6 percent. Production in Japan increased 25 percent, and there was a slight increase in production in Australia. Western Germany made considerable progress in the restoration of its pulp industry,

Table 2 — Wood Pulp: World Production and Trade Data

Region	1950 Estimates		
	Production	Imports	Exports
	(.....*Thousand metric tons*.....)		
North America	20 800	2 200	[1]650
Latin America	230	265	—
Europe	*8 420*	*2 815*	*3 800*
Northern	6 103	15	3 630
Eastern	[1]10	[1]30	1
Western	750	2 200	10
Central	[2]1 560	[2]470	[2]160
South Africa	16	2	—
Asia and Pacific	820	265	—
Total	30 286	5 547	5 450

— None or negligible.
[1] Does not include estimates for Bulgaria, Hungary, Poland, Rumania, and Yugoslavia.
[2] Does not include estimates for Czechoslovakia.

The principal countries producing wood pulp for export are Norway, Sweden, Finland, and Canada. In 1950, production appears to have increased by about 50,000 tons in Norway, by about 175,000 to 200,000 tons in Sweden, by roughly 300,000 to 350,000 tons in Finland, and by 450,000 tons in Canada. It should be remembered that in 1949 the demand for wood pulp slackened somewhat; consequently most of the increased production was from existing mills and did not represent an increase in wood pulp production capacity.

The production of greater quantities of wood pulp in the future depends not only upon installed capacity of the factories and the demand for the finished product, but also upon the supply of pulpwood and of coal and labor. The report of the Montreal Conference contains a section on pulpwood supplies which notes that the possibility of increasing supplies of pulpwood in Europe in the immediate future is slight, if care is to be taken to avoid irreparable damage to the forests or reduction in the production of other wood products. The pressure on wood pulp supplies has been reflected in the increase in price levels and has accentuated talk about the practicability of a greater use of straw and other fibrous materials for papermaking. More attention is being given to the greater utilization of hardwoods in papermaking.

To meet domestic requirements, new wood pulp mills have recently been erected in Mexico and Brazil, and plans are being made for mills in Alaska, Australia, India, and New Zealand, to mention only a few countries. In addition, many plants are increasing their capacity through modernization. New plants using fibers other than wood have been erected in Algeria, Uruguay, and the Philippines.

Cost and the uncertainty as to reliance that can be placed on continued uninterrupted supplies hinders the development and use of agricultural residues which otherwise might seem to hold promise as a raw material for papermaking.

North America

Wood pulp production capacity in North America increased some 780,000 tons between 1949 and 1950. Of this increase, 730,000 tons was for the manufacture of chemical pulp and 54,000 tons for the manufacture of mechanical wood pulp. Between 1949 and 1950 production increased by roughly 2,800,000 tons, of which 2,200,000 was chemical wood pulp and 600,000 mechanical.

Canada. Canadian production of wood pulp in 1950 is estimated to be around 7,420,000 tons, an increase of about 450,000 tons over 1949 levels. The increase in dissolving pulps is estimated to be 61,000 tons, and of kraft pulp 160,000 tons. The increased production of dissolving wood pulps at a time when cotton linters are relatively scarce takes on additional significance. Additional capacity for the production of dissolving wood pulp was scheduled to come into operation during February-March 1951. The outlook for 1951 is that expansion must be curtailed if it interferes with rearmament requirements. Output will be most affected by the supply of labor which may shift to higher paying defense employment. Higher production costs and shortages of needed chemicals may also limit production.

The production of newsprint in 1950 was 4,789,000 tons, or 93,000 tons more than in 1949.

United States of America. The production of wood pulp in the United States is estimated at 13,200,000 tons in 1950 as compared with 11,029,000 in 1949, and 11,678,000 tons in 1948. Despite this record production and the high level of imports, stocks at the end of the year were no higher than those at the beginning. However, it is believed that consumption of the finished pulp products has not kept up with production and the excess has gone into building up stocks. At the October-November 1950 levels, annual production of all paper and paperboard was at the rate of 24,240,000 tons. Production in 1949 totaled 19,250,000 tons. It is believed that controls over production of civilian goods will have their effect in the first part of 1951, and that there will be a period before military orders take up the slack. Consequently there is the feeling that the present record rate of wood pulp production and consumption will not continue long, particularly if price controls are put into effect at the same time. In addition, price controls could affect the level of imports. Shortages in the raw materials required for papermaking were appearing even though they did not have much effect on the total picture in 1950.

Supplies of pulpwood in 1950 were generally considered adequate. In the Pacific Northwest, stocks of pulpwood, which had been increased to a high level in 1949 to take advantage of low prices, were permitted to decline. The price level of logs in 1950 was high and provided an incentive for mills to keep their stocks

low. Pulpwood prices increased in the Great Lakes area, too, and mills securing their supplies from Canada in October 1950, were anticipating higher prices, particularly for peeled wood.

Of the market wood pulp available to mills which purchase such supplies, 40 percent was produced in the United States — practically the same percentage as existed prewar. While some new mills supplying market pulp have been erected during this period, others have been shut down, thus offsetting the new capacity made available.

Of the 13,200,000 tons of pulp produced in 1950, 430,000 tons were dissolving sulphite and 6,800,000 tons were bleached and unbleached kraft. Dissolving sulphite production increased by 90,000 tons over 1949 levels, and kraft production by approximately 1,400,000 tons.

Sweden

The production of wood pulp in 1950 is believed to have approached 3,075,000 tons, comprising 360,000 tons of dissolving sulphite pulps, 1,025,000 tons of other sulphite, 990,000 tons of sulphate, and 700,000 tons of mechanical pulp.

At the close of 1950 it began to appear that higher pulpwood prices were in the offing. Fuel was also becoming a problem. Supplies of coal and coke from Great Britain were reduced as Britain has trouble meeting its own requirements. In the latest trade agreement with Poland, Sweden had to increase its commitments of wood pulp to obtain the agreed quantities of fuel. There was also some question as to the continued availability in sufficient quantities of pyrite and pure sulphur, as sulphur was becoming tight in the world markets.

Finland

Production of wood pulp in Finland in 1950 fell just short of 2,000,000 tons, of which 75,000 tons were dissolving sulphite, 480,000 tons unbleached sulphate, and 760,000 tons mechanical.

France

Production of wood pulp in 1950 increased about 6 to 7 percent over 1949 levels. In view of the shortage of pulpwood, it is interesting to note that a mill has recently installed equipment capable of producing wood pulp from waste woods, primarily hardwoods. This mill is to be operated in conjunction with a sawmill.

Other Countries

Production in Western Germany in 1950 is believed to have increased about 20 percent over 1949. In Japan production has again increased and in 1950 was almost 30 percent greater than in 1949. Reports indicate that Manchuria and Korea have resumed production of wood pulp, but it can be assumed that in the latter part of 1950 such operations declined drastically or stopped completely. It is indicated that paper mills in Thailand, Indochina, and Ceylon have increased their paper production since the end of the war.

International Trade

Wood pulp entering into international trade originates primarily in Canada, Sweden, Finland Norway, and the United States. These countries' exports in 1950 were about 5,475,000 tons, some 680,000 tons greater than in 1949, and almost 1,200,000 tons greater than average annual exports during the period 1946-48. Exports to European destinations in 1950 were 2,790,000 tons, 135,000 tons greater than in 1949 and more than 800,000 tons greater than the annual average for 1946-48. In 1949, exports to North America, principally the United States, were 135,000 tons less than the annual average for 1946-48, but 1950 exports of 2,310,000 tons were 550,000 tons more than those of 1949 and 400,000 tons more than the annual average of 1946-48. Exports to Latin America increased some 40,000 tons over 1949 levels while exports to Australia and New Zealand were about the same as in 1949.

Northern European postwar wood pulp exports have been steadily increasing. During the period 1946-48 they averaged about 2,728,000 tons; in 1949 they increased some 540,000 tons over this annual average and further increased some 325,000 tons in 1950 to approximately 3,600,000 tons.

In 1950 many of the importing countries made a definite attempt to restrict their purchases in dollar areas. Consequently Sweden, Finland, and Norway, were able to reach more markets than otherwise would

Table 3. — Destination of North American and North European Wood Pulp Exports

Destination	Total			North American Exports			Northern European Exports		
	Average 1946-48	1949	Est. 1950	Average 1946-48	1949	Est. 1950	Average 1946-48	1949	Est. 1950
	Thousand metric tons								
Europe	1980	2655	2790	190	265	135	1790	2390	2655
U.S.S.R.	135	40	10	—	—	—	135	40	10
North America	1895	1760	2310	1340	1230	1725	555	530	585
Latin America	213	207	250	28	7	5	185	200	245
Africa	1	4	5	*	1	*	4	3	5
Asia	26	87	70	6	17	10	20	70	60
Oceania	55	41	40	16	3	5	39	38	35
Total	4308	4794	5475	1580	1523	1880	2728	3271	3595

— None or negligible.
* Small.

have been possible considering the world demand; at the same time North American exports to such areas were declining. In 1950 North American wood pulp exports to Europe decreased 130,000 tons from 1949 levels and 55,000 tons from the annual average of 1946-48. North American exports to Latin America decreased more than 20,000 tons from the annual average of 1946-48, and exports to Australia and New Zealand decreased 10,000 tons. In 1950 Northern European exports to Europe increased over 260,000 tons and more than made up for the decline in exports from North America. Exports to Latin America from Northern Europe increased by about 45,000 tons, and exports to the United States by roughly 50,000 tons.

In the early part of 1949 it began to appear that the supplies of wood pulp then available would be adequate for current needs. Consumers expected prices to decline, and it can be presumed that they drew upon their stocks to some extent. But toward the end of 1949 the market strengthened, and in the middle of 1950 it was clear that prices would go up. It is believed that both purchasers of wood pulp and consumers of pulp products made efforts to increase their inventories and to assure themselves, in so far as possible, of an uninterrupted source of supplies. This was particularly true in the United States.

Imports of the twelve most important importing countries are shown in Table 4. The figures for 1950 are mostly estimates derived from the available export data from Finland, Norway, Sweden, Canada and the United States. The United States, Denmark, Germany, Netherlands, Argentina and Brazil are importing more wood pulp than during the prewar period, whereas the other six countries are importing less. Wood pulp supplies in these eleven countries (excluding the United States) in 1949 were a third higher than the 1946-48 average, showing the recovery made during this period. Imports by the same group of countries in 1950 were about 5 percent greater than in 1949.

TABLE 4. — WOOD PULP IMPORTS, TWELVE PRINCIPAL IMPORTING COUNTRIES

Country	Average 1936-38	Average 1946-48	1949	Est. 1950
	(..... *Thousand metric tons* .....)			
Belgium	157	183	158	120
Denmark	48	59	62	70
France	524	268	325	430
Germany	166	[1]76	[1]274	[1]240
Italy	247	133	201	190
Netherlands	96	133	127	140
United Kingdom	1 689	982	1 341	1 450
United States	1 930	1 906	1 600	2 200
Argentina	39	50	71	70
Brazil	88	79	97	130
Japan	279	14	49	60
Australia	49	39	51	30
TOTAL	5 312	3 922	4 356	5 130
TOTAL (excl. U.S.)	3 382	2 016	2 756	2 930

[1] Western Zones of Germany.

PRICES

Wood pulp prices in the United States reached their peak in 1948, and started to decline toward the end of the year. Late in 1949, they began to level off, and during the first part of 1950, prices were steady with a somewhat upward movement for some grades. Later, prices began to rise; the increases in the last three months of 1950 were rather large, but levels were still below the 1948 peak. It seemed that prices would continue to rise in 1951 unless stopped by price controls.

The prices of Northern European pulp on the United States market are usually competitive although somewhat higher than the prices prevailing in North America and somewhat lower than most prices for comparable grades of pulp in other markets.

The price of imported wood pulp on the French market declined during the first part of 1949, but reversed itself in September of that year and continued to rise throughout 1950.

The prices of Swedish wood pulp on the United Kingdom market seemed to follow the pattern described above for prices on the United States market. Prices declined during 1949, tended to become stable toward the middle of the year, and began to rise in 1950.

In Sweden a "price equalization charge" will be imposed on all wood pulp exported after 1 January 1951, the charges to be collected by industrial organizations. Collections are also to be made from concerns not members of such organizations. The charges are to be 150 kr. per ton for papermaking wood pulp, 100 kr. for dissolving sulphite wood pulp, and 40 kr. for mechanical wood pulp. The charges are subject to quarterly revision. Payment of the funds collected is to begin in January 1958 and is to be made to producers both for export and for the domestic market, in proportion to their deliveries. With the imposition of these charges, price controls on pulp products sold on the domestic market were eliminated.

Observers on the international market have noticed that spot prices in many instances have been considerably higher than regular contract prices, but of course for limited quantities. For the last half of 1950 high prices did not seem to be a strong deterrent to pulp consumers desiring additional supplies.

Plywood

PRODUCTION

World production of plywood has shown a remarkable increase in the postwar years. As was stated in the report published in UNASYLVA, Vol. III, No. 3, estimated world production had by 1947 reached a total volume of 2,850,000 m.^{3} as compared with around 2,000,000 m^3 prior to the war. Later information indicates that the output of plywood can be estimated at some 3,140,000 m^3 in 1948 and at about 3,430,000 m^3 in 1949. In other words, the level of production at the beginning of 1950 was more than 70 percent higher than prewar.

This expansion is an expression of the growing need for finished wood products for an ever-widening field of uses. While some of these uses may be termed

"new" in that they were never previously met with material derived from timber, some of them represent examples of the substitution of plywood for lumber or some other wood product.

The increase in plywood output is due more to recovery or expansion in traditionally producing regions in response to a growing demand, than to new capacity in areas which had no real plywood industry in prewar times. There are, however, certain quite important newcomers among plywood producing countries, e.g., certain territories in Africa, and a few countries in Europe, Latin America, and Asia. Production in a number of those countries is not likely to exceed the present, relatively moderate level for some years to come, but other countries, particularly in Africa, are expanding their capacity.

As is shown in Table 1, the United States alone accounted for some 53 percent, or, with the addition of hardwood plywood, about 55 percent, of world production in 1949, as computed on the basis of reports received for the FAO *Yearbook of Forest Products Statistics*. The aggregate share of the United States and Canada represented about 58 to 62 percent of the world total. About 25 percent of the total was produced in Europe, and some 10 to 11 percent in Asia. South America and Oceania each accounted for slightly more than 2 percent and Africa for a little over 0.5 percent of the world total.

Europe

Output in the major European producing countries has generally shown a tendency to increase. The most notable increase occurred in *Western Germany* where output doubled between 1948 and 1949. During the first half of 1950, production in Western Germany reached, blockboards included, 167,000 m^3, the highest figure for any European country. During 1949 *Finland* reached its prewar production level. Output of 118,000 m^3 during the first half of 1950 was equal to the volume a year earlier. In the autumn of 1950, however, Finnish plywood production was limited by strikes.

France has also been able to increase output considerably: during the first six months of 1950 French production reached 60,500 m^3, as compared with 48,000 m^3 a year earlier.

In *Italy* the production of plywood has been hampered by lack of domestic demand. Nevertheless, the industry, comprising nearly 70 factories, is to be expanded. For instance, a plywood plant with equipment delivered from the United States is to be erected in the Calabria region.

Output in the *United Kingdom* has been maintained on a relatively high level, and there was a slight increase during the first half of 1950.

The capacity of the *Swedish* plywood industry has been increased by the completion of a new plant which, with an annual production of 20,000 m^3 of plywood and 5,000 m^3 of blockboards, is claimed to be the largest in the country. Because it is feared that the supplies of domestic veneer logs might prove insufficient, the new factory is equipped to process tropical timbers also.

While output in some Western European countries which are partly dependent on imported logs is not likely to be increased to any marked degree, there are plans for considerable expansion in many Eastern European countries, namely *Yugoslavia*, *Bulgaria*, *Rumania*, *Czechoslovakia*, and *Poland*. In addition, the capacity of the plywood industry in *Austria* has been somewhat increased.

North America

The plywood industry in the *United States* has consistently been favored by a firm demand and stable prices. Many companies have erected or are about to construct new plants. During 1949 the output of softwood plywood increased by only about 0.6 percent over the previous year's level, but in 1950 there was a very sharp turn upward. The first six months of 1950 witnessed an increase of about 39 percent in the production of softwood plywood as compared with a year earlier.

The record-breaking housing activity and, during the last months of the year, the growing military purchases, which are believed to have absorbed about 15 percent of the Douglas fir plywood production, helped to maintain the high level of production throughout 1950. Thus, production of softwood plywood in October 1950 was almost 10 percent higher than in September 1950 and some 33 percent above production reported for October 1949. The demand for plywood of all kinds being such that the sales volume was limited only by plant capacity, it was expected that the total 1950 output would be well above the 1949 figure.

Canada's plywood industry is to some extent dependent on trends in the export markets and, particularly, the demand in the United Kingdom. While the British Columbia sawmilling industry has been able to turn to the United States market in times of lack of order from other sources, the plywood industry in the same area has been barred from this outlet by a 40 percent tariff. The sharp drop in exports of Canadian plywood in 1949 resulted in a decline in production. However, the situation was changed during the first six months of 1950, and production was some 5.6 percent higher than in the first half-year of 1950.

Latin America

Plywood production in Latin America showed a definite increase in 1949, mainly owing to a rise in output in *Brazil* and the beginning of plywood manufacture in *Surinam*

Since 1947 the plywood industry in *Argentina* has been largely modernized, and output has increased by some 20 percent. New developments are reported to include the construction of a plywood plant and sawmill equipped with Danish machinery in the neighborhood of Rosario. It is expected that domestic production of plywood, nearly half of which is based on the utilization of cedar (*Cedrela fissilis*), will soon be able to satisfy all requirements and thus make imports unnecessary.

In some other Latin-American countries the plywood industry is also in a process of expansion. It is reported that there are plans for the construction of a new plant in the region of Rio Rubens, *Chile*. The only plywood company in *Colombia* is building a large plant at Barranquilla, which will be equipped with American machin-

ery. Like the parent plant at Bogota, this factory will produce hot-pressed material, mostly for door construction, to be sold on the home market. It is reported that machinery for a third factory, to be built in Cali, has been ordered from Western Germany.

The first plywood factory in *Venezuela* started operations in 1949. Approximately three-fourths of its production is for construction purposes, chiefly doors, and the remainder is to be used in the manufacture of furniture. The capacity of the factory is to be increased in the near future. In order to protect the new industry, import duties on plywood were immediately raised in Venezuela.

A new forest products company opened a veneer and plywood mill in *Panama* in October 1949. The capacity of the plant is about 9,300 m² of 1/10-inch veneer or about 2,300 m² of 1/4-inch plywood a day.

Near East

With the completion of a new factory, the *Turkish* plywood industry will consist of five plants with an aggregate capacity of 27,000 m³ per annum. As Turkey's home requirements are estimated at 15,000 m³ annually, the country will be a potential exporter of plywood chiefly to the Near East. In *Israel* the plywood mill at Afikim, which started operations during the second half of 1948, will, after the installation of an additional plant, be turning out at the rate of roughly 12,000 m² a year.

Asia

India's total annual demand for plywood is estimated at approximately 14 million m² (in terms of 3-ply, 4 millimeter), for about 5,5 million tea chests and some 4.6 million m² of plywood (3-ply, 4 millimeter) for other purposes. The plants at present operating in India have a total capacity of about 5 million m². Excellent timbers for commercial plywood, as well as for decorative veneers and plywood, are reported to be available, but the expansion of industry is hampered by foreign competition, lack of technicians, etc.

The salient feature in the field of plywood production in the Far East is the rapid recovery of *Japan's* plywood industry. In 1949 production rose to almost 350,000 m³, a figure nearly 80 percent higher than that for 1948 and considerably in excess of the prewar level.

Oceania

In *Australia* a new plywood factory, jointly operated by the Government of New South Wales and private enterprise, was opened in May 1950. Included in the federal government's plans for developing the utilization of timber resources in the Bubolo Valley, New Guinea, is the establishment of a veneer and plywood plant.

Africa

It is reported that the first plywood plant in North Africa will be established in *Morocco*. The output will originally be relatively modest, 300 m³ per month, but it can be easily increased. One half of the production will be required by the local packing industry, and the rest will be exported to Europe. There are also plans for a second plant in Morocco.

TABLE 1. — PLYWOOD OUTPUT

Country	1948	1949
	(.....Thousand cubic meters. . .)	
Europe	*710*	*900*
Austria	8	14
Belgium	12	12
Czechoslovakia	71	...
Denmark	10	9
Finland	210	231
France	86	100
Germany :		
Bizone	106	211
French Zone	9	...
Italy	80	80
Netherlands	32	20
Poland	32	...
Sweden	37	40
Switzerland	11	7
United Kingdom	39	41
U.S.S.R.	...	...
North America	*2,020*	*1,990*
Canada	286	[1]253
United States	[2]1,729	[2]1,739
Latin America	*[3]50*	*[3]80*
Brazil	60	70
Peru	*	*
Surinam	—	5
Africa	*20*	*20*
Fr. Equat. Africa	8	...
Northern Rhodesia	3	3
Southern Rhodesia	1	*
Union of S. Africa	9	...
Asia	*230*	*380*
Ceylon	[4]6	[4]5
India	20	17
Indochina	10	...
Japan	194	346
Korea, South	1	...
Lebanon	*	*
Malaya	—	1
Oceania	*70*	*80*
Australia	62	64
New Zealand	11	11

[1] Includes the province of Newfoundland. — [2] Softwood plywood only ; hardwood plywood production in 1947 is estimated to have been 325,000 m³. — [3] Shipments from plywood plants only. — [4] Year 1948/49. — * Less than 500 m³ ; — none or negligible; ... not available.

The development of the veneer and plywood industry in French territories in Africa, mentioned in our previous report, has made considerable progress. The large factory in Port Gentil, *Gabon*, was expected to be ready for the manufacture of plywood towards the end of 1950. When completed, the plant will have an annual capacity of some 50,000 m³. In Abidjan, on the *Ivory Coast* a mill producing 6,000 m³ of plywood was scheduled to start operations during 1950. The capacity of this mill can be easily raised to 10,000 m³ per year.

In the *Belgian Congo* two plywood plants in the province of Leopoldville came into operation in 1949, and a factory with an annual capacity of 3,600 m³ of plywood was expected to open before the end of 1950. The large plywood plant in Elisabethville will start production operations in 1951.

Production of the plywood plant in *Nigeria* was reported to have reached 10,000 m³ in 1948 and is planned to be increased to 12,000 m³.

TRADE

Exports

Estimated world plywood exports dropped sharply from 426,000 m³ in 1947 to 320,000 m³ in 1948. This

development was mainly due to a decline of almost 100,000 m^3 in United States exports. Reports for 1949 show that the volume of world exports rose to an estimated total of 340,000 m^3, which, while about 2 percent higher than a year before, was still well below the 1947 figure.

Estimated regional exports, representing totals of country figures reported to FAO, and figures reported from the main exporting countries for 1948 and 1949 are shown in Table 2.

TABLE 2. — PLYWOOD EXPORTS

Country	1948	1949
	(....*Thousand cubic meters*....)	
Europe	*230*	*260*
Finland	182	208
Sweden	18	25
France	14	15
North America	*75*	*43*
Canada	62	22
United States	13	21
Latin America	*15*	*32*
Brazil	13	20
Asia	*4*	*10*
Japan	2	9

The bulk of the plywood export trade was concentrated in a few countries, with more than 60 percent of the estimated world total for 1949 originating in *Finland*. About three-fifths of Finland's plywood exports in 1949 were shipped to the United Kingdom. The rest was divided between various European importers and some overseas buyers. In 1949, no Finnish plywood was exported to the U.S.S.R., which received 15,000 m^3 in 1948. In 1950, exports of Finnish plywood continued at about the same rate as in 1949. Exports during the first three quarters of 1950 were 153,000 m^3, as compared with 155,000 m^3 during the corresponding period in 1949. Also the figure for the total year 1950 remained somewhat below the 1949 exports, mainly as a result of prolonged strikes.

Plywood from *Sweden* and *France* is exported primarily to the United Kingdom. In 1949 the United Kingdom absorbed roughly three-fifths of Sweden's plywood exports and two-thirds of France's exports. During the first six months of 1950, exports from Sweden declined slightly and those from France considerably in comparison with the corresponding period a year earlier. The drop in France's exports to the United Kingdom was particularly sharp, viz., from 9,100 m^3 to 2,000 m^3.

Canada's plywood exports to the United Kingdom, which in 1948 were almost 35,000 m^3, or more than 40 percent of Canada's total plywood exports, dropped in 1949 to 8,300 m^3. During the first six months of 1950 Canadian exports to the United Kingdom were negligible. On the other hand, exports of Canadian plywood to the United States, which had declined from 33,600 m^3 in 1948 to 14,500 m^3 in 1949, increased considerably during the first half of 1950, as a result of the large construction and industrial activity in the United States, and reached the high figure of 20,400 m^3, or about 95 percent of total Canadian plywood exports during that period.

The very remarkable decline in *United States* exports in 1948 was almost exclusively due to the drop in plywood shipments to the United Kingdom from 92,000 m^3 in 1947 to 4,000 m^3 in 1948. In 1949 sales to the United Kingdom continued to diminish and were nil during the first half of 1950. Exports to all European destinations declined sharply in 1949, and the bulk of United States exports was shipped to the Philippines (10,000 m^3), India (4,000 m^3), the Union of South Africa (2,000 m^3), and some other overseas buyers.

Brazil has been exporting its plywood chiefly to Europe and Argentina. Exports to the United Kingdom declined from 15,000 m^3 in 1947 to 3,000 m^3 in 1948 and less than 500 m^3 in 1949. Considerable quantities, namely 6,000 m^3 in 1948 and 5,000 m^3 in 1949, of Brazilian plywood have been shipped to Belgium. Exports to Argentina declined from 14,000 m^3 in 1947 to less than 500 m^3 in 1948, but went up to 5,000 m^3 the following year. In 1949 Brazilian plywood was shipped to Israel and Australia in larger quantities. As exportable stocks were increasing in Brazil, the control authorities, in the spring of 1950, gave permission for exporters and importers to arrange barter transactions including exports of plywood.

Chile has recently become an active exporter of plywood. Its exports rose from 1,000 m^3 in 1948 to 7,000 m^3 in 1949. During the latter year, about one-third of the total was reportedly shipped to the United Kingdom. In 1950 important quantities of plywood were reportedly held up in the factories as a result of unfavorable exchange rates.

Surinam has entered the plywood export trade, and exported a total of 5,000 m^3 in 1949. Being tied mainly to the Netherlands market, the Surinam plywood exporters have been adversely affected by devaluation of the Dutch guilder. It is reported that trial exports to the United States have not been very encouraging.

An interesting feature in plywood trade is the resumption of activity by the U.S.S.R. and Japan. Before World War II plywood exports from the *U.S.S.R.* were about 175,000 m^3 per year. No figures on postwar exports are available. In 1947 the Netherlands, Belgium, and Denmark each imported 6,000 m^3 of plywood from the U.S.S.R., but in 1948 only Belgium reported any important purchases (close to 5,000 m^3). In 1949 the Netherlands received 6,500 m^3 and the United Kingdom 11,000 m^3 of plywood from the U.S.S.R. During the first six months of 1950, imports of U.S.S.R. plywood into the United Kingdom were 20,900 m^3.

Plywood exports from *Japan*, which in prewar times averaged some 50,000 m^3 annually, increased from 2,000 m^3 in 1948 to 9,000 m^3 in 1949. During the latter year, Australia with 7,000 m^3 was the principal buyer.

Exports from African sources have not yet reached very large proportions, as production has only started in some parts of that continent. It is expected, however, that, under favorable conditions, exports from the *Belgian Congo* could become important in 1951, and the plywood company in *French Gabon* is scheduled to start export operations this year.

Imports

The main features of the development in plywood import trade in 1948 and 1949 are illustrated by the figures in Table 3.

TABLE 3. — PLYWOOD IMPORTS

Country	1948	1949
	(.... *Thousand cubic meters* ....)	
Europe	*280*	*310*
Belgium	36	28
Denmark	4	8
Germany-Bizone	1	10
Greece	5	9
Netherlands	31	21
United Kingdom	175	210
North America	*40*	*20*
United States	38	17
Africa	*14*	*22*
Egypt	8	14
Asia	*10*	*20*
Hong Kong	*	11
Israel	...	6
Philippines	6	...
Oceania	...	*10*
Australia	*	9

The *United Kingdom* alone has been accounting for about one-half to almost two-thirds of all plywood import trade.

During 1947, 1948, and 1949, domestic production corresponded to some 17 to 19 percent of the apparent consumption of plywood in the United Kingdom. In the same years imports of plywood to the United Kingdom varied from well above 70 percent of prewar levels in 1947 to about 50 percent in 1948 and over 60 percent in 1949. During the first ten months of 1950 the United Kingdom plywood imports corresponded to 59 percent of 1938 imports.

One half of the United Kingdom imports originated in Finland in 1948, and a little more than one half in 1949. At the same time imports from Canada declined from 48,000 m^3 to 18,000 m^3 and those from the United States from 9,000 m^3 to nil. But imports from France and Sweden increased in 1949 as compared with a year earlier, and purchases from African sources and from the U.S.S.R. reached considerable proportions.

During the first six months of 1950, the United Kingdom's plywood imports were about the same as during the corresponding period in 1949. No imports from Canada and relatively high imports from the U.S.S.R. were the most important changes in this period. The partial plywood import decontrol introduced in the United Kingdom at the beginning of June 1950 did not affect purchases from most of the country's major plywood suppliers.

Belgian and the *Netherlands* plywood imports have been supplied to a large extent by Finland. Lately, the U.S.S.R. has been shipping some important quantities to those countries, and Belgium has also been importing considerable amounts from South America. During the first six months of 1950 Belgian and Netherlands purchases, particularly those from Finland, showed an increase as compared with a year earlier.

The *United States* imports of plywood originate chiefly in Canada. During the first half of 1950 imports from that source were 13,800 m^3 as compared with 4,300 m^3 during the corresponding period in 1949.

Denmark's imports declined slightly during the first six months of 1950, while those of *Western Germany* increased somewhat.

Prices

Plywood has been described as the most versatile building material. For certain uses plywood is so superior to competitive materials that it can bear relatively wide fluctuations in price. For instance, the use of large sheets of plywood as subflooring material in the United States involves such savings in labor that the demand for this purpose is not greatly affected by changes in prices. In most uses, however, the demand for plywood is dependent on the relationship between plywood prices and prices of competing materials, such as lumber and various wallboards, etc.

In the United States, Douglas fir plywood prices in 1948 were almost 200 percent higher than in 1939. They declined about 35 percent by August 1949, but demand then strengthened and prices rose gradually. A partial shortage of suitable peeler logs was also reported to have had some effect on the price trend. By November 1950, first quality plywood logs reached prices between $110 and $120 per thousand board feet, a level never seen reached before.

On the international market there was a more fluctuating tendency. Finnish export prices for birch plywood averaged 24,500 Finnmarks per m^3 during the first half of 1949, climbed to an average of 28,300 Finnmarks in December 1949, but dropped almost 7 percent in January 1950.

The average c.i.f. import values of plywood (including laminboard, blockboard, and batten board) received by the United Kingdom during the first ten months of 1950 showed a considerable decline as compared with the average for January-October 1949. Average values for imports from Finland had declined from £47.0.4. to £40.9.0. per m^3, and those for all imports of birch plywood from £46.11.6 to £39.8.5. per m^3.

Negotiations regarding 1951 prices between the British Timber Control and Finnish and Swedish plywood exporters resulted in somewhat increased prices.

The Work of FAO

Expanded Technical Assistance Program

AS was described in the special Technical Assistance number of UNASYLVA (Vol. IV, No. 4), the Expanded Program (ETAP) is administered and financed outside the regular program of FAO.

The position of ETAP up to the end of July was that over 40 technical experts had been recruited for various assignments in the field of forestry and forest products, and nearly three fourths of these were already in the field. The total expenditure authorized for these experts, and for the various projects falling under the new program, already cordially exceeded the annual budget of the Forestry Division for its regular program of work so that, in fact, technical assistance has rapidly become the action arm of FAO.

Of the funds authorized to date slightly more than a half has been allocated for work in Latin-American countries, 45 percent for Asia and the Far East, and 2 percent for Europe and Africa. Missions or individual experts have been or are being sent to 17 countries, including Austria, Brazil, Burma, Ceylon, Chile, Colombia, Ethiopia, Guatemala, Haiti, Honduras, India, Indonesia, Iran, Mexico, Pakistan, Thailand, and Uruguay. The general nature of the assignments and of most of the projects involved were described in the last issue of UNASYLVA, but since then important agreements have been concluded between FAO and the governments of Brazil, Chile, Mexico, Ethiopia, and Iran.

In Ethiopia, advice will be furnished on the possibilities of developing the forest economy of the country and with regard to formulating and implementing a definite forest policy. A mission recently sent to Iran included a technical adviser on wood technology and forest products research, an expert on forest range management, and another on charcoal production. In Mexico, technical assignments cover forest products research, forest products industries, inventories of forest resources, reforestation, and forest entomology. The chief of mission, D. T. Griffiths, has served on the FAO staff for the past year in a special capacity, while the chief of the mission of five to Chile is E. I. Kotok. In Chile, emphasis will be placed on forest protection, soil conservation and rehabilitation through reforestation, forest management, and forest products industries. In Brazil, three experts will carry out initial investigations into the Amazon Valley development project, on which FAO lays great stress. Logging and floating possibilities, the development of forest industries, and marketing and distribution problems will be examined.

Finally, although the original missions were carried out in 1950 under FAO's regular program and not under the expanded program, it is appropriate to mention here two reports which have been released since publication of the last article in UNASYLVA. These are the reports of the FAO forestry missions for Nicaragua (published in UNASYLVA Vol. IV No 2) and for Ireland. The latter report endorses the Government's afforestation project for the planting of a million acres of forest, over a 40-year period, as part of the country's long-term program of economic development.

Cork Oak: Permanent Working Party of Mediterranean Subcommission

At its last meeting in 1950, the Mediterranean Subcommission of FAO's European Forestry and Forest Products Commission decided to set up a permanent working party on cork. An initial meeting of this party, under the chairmanship of Professor J. Vieira Natividade, was held at Lisbon, 14-18 May 1951, and was attended by experts nominated from France and the French Union (Metropolitan France and Morocco), Italy, Portugal, and Spain. Many observers from the two latter countries were also present.

The group made a broad survey of the problems connected with the cultivation of cork oaks and the present outlets for cork products. It called upon countries concerned to encourage the cork industry and to investigate new uses, the possibilities of chemical utilization, and markets for inferior quality cork, so as

One aspect of the Portuguese cork industry seen by delegates to the May, 1951 meeting of FAO's Permanent Working Party on Cork is pictured above: the unloading of raw cork by the Transport Agency Munaet al Sexal.

(*Another photo on next page*).

to offset the competition now appearing from substitute products

A questionnaire was drawn up for national inventories of cork oak forests and for statistics of production and trade in cork. Discussion also centered on research which should be undertaken on regeneration and sustained yield; pests and diseases; protection of cork oak forests; and silvicultural techniques. A standard management record form for individual forests and plantations was approved in outline and will be submitted for final consideration to the next meeting of the working party, which, it was decided, should be held at Madrid in the Spring of 1952.

The successful establishment of this working party aroused keen interest in Portugal, where, in 1950, cork exports amounted to about $30 million. The meeting was opened by the State Under-Secretary for Agriculture, in the presence of the Director-General of Forests and the Vice-President of the National FAO Committee for Portugal. Field trips were made to local cork oak forests and cork industries, to the Botanical Gardens at Sintra, and to the Institute of Agronomic Research.

Another view of the Portuguese cork industry as seen by delegates to the May, 1951 meeting of FAO's Permanent Working Party on Cork. It is a plantation of cork oaks at Rio Friou; pigs graze beneath the trees.

Personalities

With the move of the headquarters of the Organization from Washington to Rome, FAO lost the services of two members of the staff who had served with distinction in the Forestry Division since its earliest days.

J. D. B. Harrison was a member of the Technical Committee on Forestry and Primary Forest Products which reported in November 1944 to the United Nations Interim Commission on Food and Agriculture, with regard to the inclusion of forestry in the scope of FAO. He acted as adviser to the Canadian delegation at the first session of the FAO Conference held at Quebec in 1945, and soon afterwards joined the secretariat as Chief of the Forest Economics Section. In this capacity he made a remarkable contribution to the work and activities of FAO over the following years, not the least of his endeavors being the carrying out of the world inventory of forest resources in 1948, and the production of the FAO Study, *Planning a National Forest Inventory*, in 1950. His varied experience and knowledge will be hard to replace. He has returned to Canada as Associate Director, Research Division, Forestry Branch, Department of Resources and Development, Ottawa.

To *J. P. Kagan* must in large measure be attributed the credit for the organization and development of the statistical work of the Forest Division. As head of the statistical unit he was responsible for the production of four Yearbooks of Forest Products Statistics, and was called upon to provide facts and figures in every field of the Division's activities. Mr. Kagan has now joined the Forest Products Branch, Office of International Trade, United States Department of Commerce.

In Rome a new staff member has been welcomed in the person of *I. T. Haig*, who will be in charge of research and technology. Dr. Haig has directed the Southeastern Experiment Station, North Carolina, U. S. A., since 1944. He was formerly chief of the Division of Forestry Management Research of the U. S. Forest Service at Washington, D. C., and in 1943-44 headed a mission to survey the forest resources of Chile and recommend a development program.

Equipment News

The continual development of forestry utilization and woodworking industries is reflected in the increas demand for information on new equipment. FAO's Forestry Division, on the recommendation of the FAO Conference, collects such information and sends it on request to member nations. There is also a regular feature in UNASYLVA dealing with new equipment, and the Forestry Division appreciates receiving data fro manufacturers all over the world. Specifications should be accompanied by clear, sharp photographs (glossy prints) of the equipment. FAO, however, can accept no obligation to publish all such information received.

MOTOROLA HANDIE TALKIE. — FM 2-way radio - 25-50 MC 1/2 watt. Dimensions : 10 in. high (25.4 cm.) by 12 5/8 in. long (32 cm.) by 3 1/8 in. wide (8 cm.). Total weight including batteries, Handset antenna, and carrying strap: single transmitter unit, 9.8 lb. (4.445 kg.) ; dual transmitter unit, 11.5 lb. (5.217 kg.).

This handie talkie is particularly suited for use in lumber camps and for forest fire fighting because of its light weight and compactness.

Motorola Inc. Communication Division, Chicago 51, Ill., U. S. A.

CATCHMENT BASIN FOR RAIN WATER WHICH CAN BE USED FOR HELICOPTER LANDINGS. — This reservoir was designed in California by the U. S. Forest Service. It is intended for collecting rain water to be used later for fire fighting. The area of the platform has been calculated to allow for the collection of 5,000 gallons (22,500 litres) ; account has therefore been taken of the average rainfall of the region which amounts to 17 inches (43.2 cm.). If the platform is to be used as a landing ground for helicopters it is necessary to reinforce it to the required strength The example shown in the photo graph does not have the usual ridge around the platform which prevents the water from overflowing in the event of a high wind.

United States Department of Agriculture, Forest Service, California Region, 630 Sansome Street, San Francisco 11, California, U. S. A.

CONCRETE POTS USED IN NURSERIES. — Since all evergreens and most coniferous plants in Israel are raised in nurseries in receptacles such as earthenware pots and petrol tins, which are scarce, the problem has been solved by producing concrete tubs. Two types are in use : the usual conical form and a square one, each type being made in four different sizes. The square type is easier to handle and therefore more economical in the nursery.

After a comparatively short time in use, the following conclusions were reached : (1) Concrete pots are much stronger than earthenware pots and last longer.

(2) The pots can be manufactured quickly in large quantities as they are produced in molds.

(3) Initial cost of production is lower than that of earthenware pots, which require baking, and in the long run even cheaper than tin.

(4) The cost of the equipment used for mass production is very small and materials required are available in the country.

(5) When placed tightly side by side weeds cannot grow between the pots, and also no water is wasted.

Forest Service, State of Israel.

SURVEYING INSTRUMENT. — This instrument, which is described in the *Indian Forester* of October 1950, can be used for lay-out angle levelling — determining clinometric heights — measuring vertical and horizontal angles etc.

Indian Forester, October 1950

TREE PLANTER. — This machine can be used in sandy soil or heavier clay and loam soils. The hydraulic lift easily raises the blade and operator for fast moving and turning. A large 30-in. coulter lifts the planting shoe over logs, large roots and stumps. The carriage is made of tubular steel, and is mounted on 600×16 pneumatic tires.

Forestry Equipment Co., 2939 West Beaver Street, Jacksonville, Florida, U. S. A.

HENRY NO. 500 "SILVER GIANT" POWER SHEAR. — The Silver Giant operates with 125 lb. air pressure. It cuts 2-in hardwood branches cleanly with one stroke trigger action, at a rate of 25 cutting strokes per minute.

It is available in lengths from 3 to 10 ft., and is made of lightweight

aluminium alloy with jaws of tempered steel.

Remsen Advertising Agency, Inc., 250 Church Street, New Haven 10, Conn., U. S. A.

BELT FIRST AID KIT. — The kit contains the following first aid material: 2 sterilized gauze bandages, 1 tube white petroleum jelly, 1 snake bite kit, 1 pkt. merthiolate, breakable pearls, 3 triangular bandages (not sterile), 1 plastic card (contents and first aid instructions), 1 pkt. aspirin tablets, 5 gr., 1 pkt aromatic ammonia pearls, 1 pkt. 1-in. adhesive compress, 2 rolls adhesive tape, 1 bandage compress 4-in., (sterile), 1 pkt. safety pins.

United States Forest Service.

THE FERGUSON POST HOLE DIGGER. — The Ferguson Post Hole Digger is a power driven implement designed for easy attachment to a tractor. It can be operated by the driver from the tractor seat. Two sizes of augers are fitted with replaceable screw points and replaceable hardener cutting blades and are designed to drill holes of 9 in. or 12 in. diameters to a maximum depth of 36 in.

Harry Ferguson Ltd., Coventry, England.

"LES GRIMPETTES". — This apparatus is used for climbing trees, principally for collecting seeds and for pruning. It is composed of two similar parts, one for each leg. Each has a vertical carrying arm to which is attached, *on the lower part*, a pedal with two straps, one in the front and one at the back of the leg, and *on the upper part*, a clamping device revolving on a horizontal axle into which is fixed one of the ends of the steel band; the other end is inserted back in the jaws and can be adjusted to fit the diameter of the tree by means of a lever; a supporting block with a bumper is fixed at the upper part of the carrying arm. A coil-spring is placed between the clamping device and the supporting block and is intended to keep the band free of weight in an appropriate position. In order that both feet may rest at the same level the two carrying arms are not of equal length.

Fritz Schneebeli, Hardturmstrasse 74, Zurich, Switzerland.

PORTABLE WOOD CHIPPER. — Several American and Canadian firms are now turning out portable wood chippers. Mounted directly on a tractor, truck or trailer, they are used mostly by farmers and private forest owners to break up discarded timber for sale to paper and fiberboard factories.

Tests of these machines in North America have proved them satisfactory for cleaning up cutover areas. They generally consist of a drum in which blades turn at from 1,000 to 3,000 r.p.m., depending on the model. Chunks of wood up to 6 1/2 in. (15 cm.) diameter can be cut up. The chippers are powered either by a separate motor of from 20 to 30 h. p. or by the vehicle motor if mounted directly on the chassis.

Fitchburg Engineering Corp., Fitchburg, Mass., U. S. A.

FLECO DETACHABLE STUMPER. — The Fleco Detachable Stumper for use with a Caterpillar tractor bulldozer arrangement. The illustration shows the same detachable stumper from a side view. The face is curved so that the stumper can get under the stump and pick it up; at the same time the sharp teeth, with the power of the tractor, cut or break the lateral roots. The detachable stumper will penetrate the ground up to approximately 24 in. and will cut a path between 30 in. to 36 in. The full power of the tractor is concentrated in the area of the stumper.

Florida Land Clearing Equipment Co. Jacksonville, Florida, U.S.A.

THE AUTOMULE. — The *Automule* is a load-carrying track-laying tractor designed especially for logging under difficult conditions such as may be encountered in mountains. In the case of highway hauls, the *Automule* can be put on four pneumatic-tired wheels.

Specifications: *Model M 25*: Engine, 2 cyl. Steyr WD 213; power: *26* h. p. at 1,500 r. p. m.; *Model M 60*: Engine 4 cyl. Steyr WD 413; power, 60 h. p. at 1,500 r. p. m.; fuel consumption, 180 to 200 grams/hp/hr

Three forward and three reverse speeds; speed range on crawler tracks is 1.61 to 4.47 m. p. h., and 4.25 to 11.93 m. p. h. on wheels, for both machines; with over-drives maximum speeds can be increased to 5.59 and 9.07 m. p. h. on crawler tracks and to 14.5 and 24.09 m. p. h. for wheel tractors. Maximum drawbar pull is 4,474 lb. for the small model and 10,403 lb. for the larger model. Logs can be loaded either on to a semi-trailer or directly on to the back of the tractor. An arch or skidding pan can be attached to the tractor. A winch can be fixed to the front

in addition to one or two auxiliary winches at the back; every known method of rigging can therefore be employed. Each track has an independent brake which facilitates maneuvrability on winding roads

Motormuli, Schuster, Hacker & Co., Komm. Ges., Erzeugung von Holbringungsgeräten-Geschäftsleitung, Wien 16, Nauseagasse 25, Austria

VICKERS TRACTOR VR-180. — Belt horsepower 180, drawbar horsepower 150; speeds: 6 forward, 2 reverse. Engine: Rolls Royce, 6 cylinders; r. p. m. at full load, 1,800. Over-all length, 14 ft. 7 5/8 in.; over-all height, 7 ft. 2 5/8 in.; width, 8 ft. 8 in. Ground clearance: 10 in. Weight (shipping): 32,500 lb.

Jack Olding and Co., Ltd., Hatfield, Herts, England.

EUCLID TRACTOR. — Engine: Buda model 8 DC 1125, 8 cylinders, 240 h.p. at 1,800 r.p.m., 5 speeds forward and one reverse. Length over-all, 21 ft. 2 1/2 in.; width over-all, 10 ft. 6 1/2 in.; weight, 31,000 lb.; weight of load hauled per trip, 535 tons.

G.H. Godsall Equipment Co., Ltd., 213 Bay Street, Port Arthur, Ont., Canada.

DROTT SKID-LOADER. — This equipment is to be mounted on International and Allis Chalmers tractors. Two models are built : *Model 35* for International T and TD-9 and Allis Chalmers HD 5 — lifting capacity, 4,000 lb. (1,814 kg.); loading height above ground, 11 ft. 6 in. (3.50 m.). *Model 60* for International T and TD-14 and Allis Chalmers HD-9 — lifting capacity, 6,000 lb. (2,720 kg.); loading height above ground, 12 ft. 6 in. (3.81 m.).

Drott Manufacturing Corporation, Milwaukee 8, Wisconsin, U.S.A.

HAULING WINCH. — The windint drum of the winch is vertical. Ig is composed of a bridge turning round its axle, bearing on the sprag anchor. This bridge is locked after each operation so that the load is transferred to the tangential point of contact on the drum ; thus the tractor does not take the load regardless of the direction of the haul. For this reason it is possible to perform all kinds of discharging work without being obliged to alter the position of the tractor after each operation. These winches are readily adaptable to all types of tractors built for the hauling of three and five tons and will take about 100 meters of cable.

Bennes Avia, 55 Avenue Georges V, Paris 8e, France.

GORWOOD CIRCULAR GANG SAW. This saw is used to convert small round timber 2 to 11 in. in diameter and 2 to 18 ft. in length into lumber. The saw makes two cuts in one operation. The two circular blades can be opened from 1 to 9 in. A revolving disc is fitted between them so as to put pressure on the log.

Feeding speeds 20 to 90 f.p.m. An endless chain for continuous feeding runs centrally between the saws to which logs are fitted. These can be adjusted to any position in a few minutes for working short or long logs. The chain feed is controlled by a foot treadle bar.

Capacity of the machine when producing, for example, 3-in. squares at 40 feet per minute, is 60 cu. ft. per hour. Power unit is either electric or 1 cyl. engine.

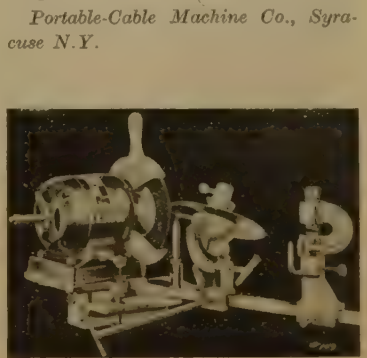
Specifications : Maximum distance between saws, 9 in. ; minimum distance between saws, 1 in. ; maximum depth of cut, 10 in. ; maximum length of log, 18 ft. ; minimum length of log, 2 ft. ; speed of pulley, 1,250 r.p.m.; power required, 45 h.p. ; size of saws (inserted tooth recommended), 30 in. ; space occupied, 36×2 ft.

J.R. Gordon and Co., 14-16 Newgate Street, Chester, England.

NEW TILTING ARBOR SAW TABLE. — Ease in carrying is the ousstanding feature of this saw table that weighs only 44 lb. The top of the table is designed to flip over ; the portable saw can then be fitted into position in 60 seconds. When the top is dropped back into place, the table automatically locks into position and is ready for use.

Specifications : Table size 26 in deep, 20 in. wide ; blade 8×7½ in.

Portable-Cable Machine Co., Syracuse N.Y.



GORWOOD MULTIPLE RESAW. This machine can resaw lumber up to 3 in. thick, 6 in. wide and 14 in. long. As many as 12 saws can be used at a time and are held apart by metal pieces on a sleeve which fits on to the spindle of the machine. Feeding is by overhead machine cut rollers with a range of 20 to 90 f.p.m. Foot pedals are used for raising the feeding head.

Specifications : Maximum size of saw, 10 in. ; maximum no. of saws, 12 ; maximum depth of cut, 3 in. ; power required, 45 h.p. (for average work) ; spindle speed, 4,500 r.p.m. ; feeding speed, 20 to 90 f.p.m. ; space occupied, 16×3 ft.

J.R.Gordon & Co., 14-16 Newgate St., Chester England

GORWOOD FOOT-OPERATED SWING CROSSCUT SAW. — This saw works on the pendulum principle. The operator can bring the saw forward by depressing the stirrup with his foot, thereby leaving his hands free.

Capacity, approx. 1,000 cu. ft. per day with crew of four men. Power unit, either electric or 1 cyl. engine.

Specifications : Maximum size of saws (inserted tooth recommended), 36 in. ; maximum depth of cut, 11 in. ; power required, 10 h.p. ; speed of pulley 1500 r.p.m. ; space occupied, 5×2 ft. ; weight, 10 cwt.

J.R. Gordon and Co., 14-16 Newgate Street, Chester, England.

LOG-GRAPPLES FOR PAPER FACTORIES. — These grapples are used for unloading logs in bulk, and are composed of two shells with parallel claws. They can grab logs from 1 m to 1m. 20 long and from 100 mm to 350 mm. in diameter.

Bennes Avia, 55 Avenue Georges V Paris 8e, France

BELSAW CIRCULAR SAW SHOP. — The photograph shows the Belsaw circular saw shop with an 8-in. diameter crosscut blade positioned at 30° angle for grinding and shaping teeth with bevel cutting edge.

The Belsaw circular saw shop is designed to handle all types of circular saw from 4 to 48 in. diameter with arbor holes from 1/2 to 2 in. The complete assembly includes 1/4 h.p. motor, 3,450 r.p.m., for 110-120 volt, 60 cycle AC power.

Belsaw Machinery Co., 315 Westport Road, Kansas City 2, Mo., U.S.A.

PORTABLE STAVE MILL. — The photograph shows a complete portable stave mill, used for cutting white oak staves.

Manufacturer: Lewis Diesel Engine Co., P.O. Box 2828 Desoto Sta., 92 West Caroline Ave., Memphis, Tenn., U.S.A. (Photo By E. H. Jaffe. 160 Union Ave., Memphis, Tenn., U.S.A.)

ROSS SERIES 100 STRADDLE CARRIER. — Capacity 45,000 lb.; load height 66 in.; width 64 in.

The Ross Carrier Co., Benton Harbor, Michigan, U.S.A.

FORK LIFT DUMP BOX. — This fork lift dump box was developed as a means of transporting mill refuse, for loading mill blocks and short slabs on to trucks and, in some cases, for feeding sawdust into boiler hoppers.

Specifications: Width, 6 ft.; length, 8 ft.; weight, 1,600 lb.; capacity 144 cu. ft.

C & D Welding Service, South Market and Veda Streets, P.O. Box 1787, Redding, Cal., U.S.A.

News of the World

The items appearing here are condensed selections of news thought to be of interest to readers of UNASYLVA. *They are grouped alphabetically by countries under headings currently used by the Forestry Division for reference purposes. The Editor will be glad to receive direct from readers authenticated items of interest and of news value for this part of the review.*

General

FINLAND

• Annual Forest Weeks have been organized in Helsinki by the Finnish Forest Association (Suomen metsanhoitoyhdistys) in conjunction with specialized forest associations, most of which have come into existence during the past two decades. The meetings were first organized in 1925, they usually take place either at the end of March or in the early part of April; during the past 20 years there have been 18 meetings, none were held in 1940 or in 1942 on account of the war.

The purpose of these meetings is to exchange information and to help establish contacts between members, with the object of avoiding the dangers of over-specialization. During these Forest Weeks there is one general, joint, session as well as annual meetings of the various associations. A large number of papers have been presented, 530 to date, and 77 topics have been discussed. Of the papers, 63 have been presented by foresters or scientists, 289 by various technical experts, and 20 by visitors.

The results of scientific research have been published, and the consultations and discussions during the Forest weeks have had considerable influence on forest and industry management. The most important discussion group is always the one dealing with wages, employment, and working conditions of foresters. Through the presence of non-professional observers and of the press the discussions have received wide publicity. This has led to a more general interest in forestry and allied sciences. Several associations have held jubilees and festivals during the Forest Weeks, and through these, the activities of specific associations have become more widely known. Representatives of different interests, and of various professions, having become better acquainted, now work together more confidently. Swedish foresters are regularly invited to the Finnish Forest Weeks, while Finnish foresters attend the Swedish Forest Days, both groups learning of each other's forest problems. Altogether, the Forest Weeks serve a valuable purpose for forestry and timber sciences. They also constitute an asset for forest management in the whole of Finland.

UNITED STATES OF AMERICA

• A bibliography on the *Economics of Forestry*, covering English language publications in the United States and Canada, from 1940 through 1947, has recently been published, bringing up to date earlier bibliographies in the same field. About 3,800 items were retained out of about 10,000 examined, covering publications on value and price aspects of: (1) forest and forest-land use and tenure; (2) forest management, for timber, water, forage, wildlife, recreation, or other forest products; (3) industry based directly on forest products; (4) marketing of forest products; and (5) consumption of forest products. Borderline references and those dealing with economics in general were omitted. The bibliography is arranged in chapters dealing with; (1) forest economy in general; (2) land management; (3) forest management; (4) management of forest-product harvesting and processing; and (5) the meeting of supply and demand. Thus, from the general aspects through successive stages of economic activity, from the forest to the consumer of forest products, each chapter is subdivided, dealing specifically with regional conditions where that is appropriate. The bibliography contains a complete subject and author index. Brief annotations are given for references for which the title itself does not give reasonably good specifications of the content. This is one of the accomplishments of the joint undertaking of the Society of American Foresters and the Charles Lathrop Pack Forestry Foundation in the general project concerned with scope and method of research in the economics of forestry.

Fundamental Science

UNITED STATES OF AMERICA

• A soil scientist at the California Forest and Range Experiment Station has patented a new instrument for measuring water in the soil. The instrument can be used in studying water use by plants, in measuring the direction and rate of water movement in the soil, and for the detection of freezing and melting of soil water. It is based on electrical resistance. Research on the instrument was started in 1936. About 3,000 of the units are now in use in different parts of the United States and in Australia, Canada, Cuba, Hawaii, Israel and Puerto Rico.

UNION OF SOVIET SOCIALIST REPUBLICS

• The year 1950 marked the fortieth anniversary of the first Russian Control and Experimental Seed Station established in St. Petersburg, now Leningrad. The tasks set before the Station were testing seed of forest trees, determining the effect of the source of seed upon resulting tree growth, studying the effect of weather, site, and other external factors on the occurrence of good seed years. At the same time, it was engaged in developing new, more rapid, and more precise methods of seed testing in general. In the course of these forty years, the Station has made more than 36,000 analyses of seed samples and has accumulated an enormous amount of experimental material. The results of these investigations are now being brought to light. To mention only a few of the findings: the length of the period during which germination takes place (total germination) is in direct ratio to the quality of the seed; the lower the germination percent, the longer the dormancy period. Oak acorns, for example, having a germination percent of between 7 and 15, begin to sprout under laboratory conditions only on the fortieth or fiftieth day; with a germination percent of 90, they sprout on the twentieth day. Changes in temperature, even within the limits of 5° C., act as a stimulant in hastening germination and shortening the dormancy period. Light is an essential factor in germination. The most favorable light condition for seed germination is diffused daylight. Deficiency of light has an unfavorable effect, especially on poor quality seed. Seed of the same spe-

cies, but coming from different regions, varies in germinating energy and capacity. Observations of 3,500 different seed samples over a period of 15 years revealed a definite correlation between the germinating energy displayed during the first few days (3-5 or 7 days) and the final or total germinating capacity of the seed. This makes it possible to express the actual final germinating capacity with 10 percent accuracy and offers a quick method of seed testing. On the basis of large-scale experiments, it has been determined that for practical purposes a sample should consist of not less than 500 seeds, and for scientific purposes, 800 seeds. It has been found possible to shorten the period of total germination in the case of pine, spruce, larch, and birch to 15 days. Observations on the amount of seed produced in different years has led to the adoption of six classes of seed crops into which crops can be grouped according to size. Experiments on raising the seed-bearing capacity of trees by cutting the roots or branches, girdling and similar methods used in horticulture, did not show any positive results. However, thinning the stands intended for seed production has been found the best and most practical method of raising the yields of forest seed, especially if carried out when the stands are still young.

Silviculture

Canada

• The British Columbia Forest Service has issued Technical Publication T. 32, *The Development of the Spruce-Balsam Type*, which sets forth the conclusions derived from experiments and measurements carried out over the past 30 years on 27 permanent sample plots set aside in the Aleza Lake experimental forest for the study of a typical, mixed spruce-balsam forest (*Picea glauca-Abies lasiocarpa*), which covers 4 million acres (1,6 million ha.) in British Columbia and constitutes one of the main lumber reserves of that province. The study concerns two types of stands: (1) virgin stands; and (2) culled stands where there is a more or less heavy residual stand with good advance regeneration in which balsam fir predominates in the ratio of 4 firs to 1 spruce.

Measurements of the gross and net increment and of the rate of mortality in the virgin stands show, as might be expected, that the average annual volume of dead wood closely approximates the average annual gross increment, which amounts to approximately 90 cubic feet per acre (6.3 m³ per ha.). However, a more detailed analysis indicates that the gap between the net and gross increment is due mainly to the presence of balsam fir whose rate of mortality exceeds its gross increment in all trees in the 9 inch (23 cm.) or over diameter-class, while the annual gross increment of spruce becomes incorporated in the stand to an extent varying between 10 and 100 percent, depending on the diameter categories.

Thirty years of observation of the second-growth stands which are released after logging, in which all spruces over 11 inches (28 cm.) in diameter and all firs over 9 inches (23 cm.) are removed, confirms the foregoing results. The mortality rate during the first seven years following logging was not actually measured, but was no doubt low; the rate was slightly higher for spruce and much higher for fir during the following 13 years and then fell off considerably, although it remains much higher for fir than for spruce even from the twentieth to the thirtieth year.

The average annual periodic increment which fell to 42.7 cubic feet per acre (3 m³ per ha.) during the first seven years, later increased to 91.9 cubid feet per acre (6,4 m³ per ha.) during the subsequent 12 years and finally jumped to 151.1 cubic feet (10.6 m³) from the nineteenth to the twenty-ninth year.

An analysis of this increment indicates that it is concentrated mainly in the advance regrowth standing before logging, or, more accurately, in spruce between 1 inch (2,5 cm.) and 11 inches (28 cm.) in diameter and balsam between 1 inch and 8 inches (20 cm.) in diameter left standing after logging. This indicates the importance of leaving the residual stand in as good a condition as possible. Although such a stand has a larger proportion of fir (the less valuable species), the second cutting, approximately 40 years after the first, will nevertheless yield proportionally a much higher quantity of spruce, because of the higher rate of mortality of fir.

The authors conclude that the great risk involved in retaining spruce over 12 inches (30 cm.) in diameter following logging and the entirely disproportionate danger involved in the retention of firs over 9 inches (23 cm.) in diameter entirely justifies modern practice in virgin forests of felling all large-diameter trees. Even if a comparatively short rotation period were allowed, other felling methods would prove to be less satisfactory. By felling all firs over 9 inches (23 cm.) in diameter and all spruce over 13 inches (33 cm.) a residual stand will be left which can attain full growth within 50 to 70 years. At the end of this period, the age and diameter distribution in the stand will permit the application of silvicultural methods for the complete utilization of all the wood growth. This conclusion may surprise foresters accustomed to intensive silviculture which calls not only for the adoption of very brief rotation periods, but also for the gathering of windfalls — so that the volume of wood extracted from a forest could be practically equal to the gross wood increment. The problems arising in this instance are entirely different first, because the rotation period is necessarily rather long and, secondly, because it is necessary to transform virgin forest into managed forest. Under these circumstances, the solution found most expedient in the light of past experience is also doubtless the best.

Southern Rhodesia

• Provision of fodder reserves for the 8-months' dry season is ordinarily accomplished by plowing the natural veld and growing drought-resistant annual crops. This practice normally leads to severe erosion and thus the suitability of native leguminous pod-bearing trees for production of fodder is of interest. There are at least five species of acacia and, in addition, *Dichrostachys glomerata* and *Piliostigma thonningii* which produce large crops of edible seeds. The pods and spongy tissue of all these species are digested but the hard-coated seeds are not, and thus when the pods are eaten by cattle the seeds are widely distributed. All these species protect the soil against erosion. The seeding value of the pods is approximately equivalent to British meadow hay as a source of digestible proteins and is superior as a source of energy on a dry weight basis. The pods are superior to good veld hay and greatly superior to ordinary veld hay. Knowledge of the yields of pods is fragmentary, but it is probable that from 4 to 8 large trees per acre (10 to 20 per ha.) of three acacia species, and from 10 to 20 of the smaller trees per acre (25 to 50 per ha.) of the other species, would produce a yield of pods of from 1,000 to 2,000 lb. (1,120.8 kg. to 2,241.6 kg. per ha.) per acre for the first group and from 250 to 500 lb. per acre (280.2 kg. to 560.4 kg. per ha.) for the second, and would not interfere with yields of grass on the same area. Average yield of veld hay is only between 500 and 1,000 lb (560.4 kg. to 1,120.8 kg. per ha.) per acre. Propagation can often be accomplished by selective clearing and thinning of dense brush in which the desired species occur and, in some cases, by planting. It thus appears that greater attention might well be directed to the propagation of these forage-yielding tree species in addition to plowland crops, because they not only constitute a source of forage but contribute to soil conservation as well.

United Kingdom

• In the British Isles the most important factor in determining the altitude to which commercial timber cultivation can be extended is that of exposure, the effects of which are most serious on the western seaboard and in such areas as Northern Ireland. Of the coniferous species so far given extensive tests on exposed high altitude sites, the most satisfactory has proved to be *Abies procera* (*A. nobilis*). This has proved particularly effective when grown in pure stands planted at a spacing of 6 by 6 feet (1.83 by 1.83 m.). Of the other species tested, Sitka spruce (*Picea sitchensis*) is satisfactory where soil moisture is suitable, but not on dry soils. The larches are unsuitable, Scots pine (*Pinus sylvestris*) suffers defoliation and fails, and each variety of *Pinus contorta* has disadvantages. Scarcity of seed has resulted in planting the *Abies procera* mostly in mixed stands, but if supplies of seed can be increased, more extensive planting in pure stands on high exposed dry sites is desirable.

Logging and Engineering

Union of Soviet Socialist Republics

• A comparison of the efficiency of two methods of logging has shown interesting results: one method, widely used within recent years, is to haul the entire length of the trunk to a clearing (loading yard) where it is sawn into logs and other forest products. Before hauling, the trunk is cleaned of all branches. The other is a development of this method, and has been tried out with success on logging operations in forests of the Leningrad province. The whole tree, branches and all, is hauled as felled to a clearing where the branches are sawn off and the trunk cut up into log lengths according to the quality and use to which they are to be put. The hauling is done by power windlasses. When the tree moves with the top forward and elevated it is seldom caught on stumps or roots. This enables almost twice the number of round hauls to be made and does away with the need for some workers to follow the loads, as is usually the case when the whole trunks are hauled. The latter method gave 16 percent better results than the former (54 m^3 per day against 47 m^3). Other advantages were found to be: (1) Fewer men were required to saw off and collect the branches. When the branches were removed at the felling site 8 workers were required; in the loading yard 5 workers did the job or 1.5 times less. (2) The efficiency of the workers increased. With fires burning continuously, the unwanted branches were more quickly disposed of (10.8 m^3 per man-day in the loading yard and 5.9. m^3 at felling sites). (3) The quality of the work improved. The branches were cut cleaner and closer to the bark. The logs were not charred as is often the case when the slash is burned before the logs are removed. Greater mechanization was possible. (4) Concentrating the side branches in one place meant that they could be utilized for fuel and for the chemical industry; at the loading yard there were railroad transportation facilities. (5) Conditions of work were less hazardous.

Forest Injuries and Protection

Canada

• In eastern Canada the imported European pine sawfly (*Neodiprion sertifer*) is a major pest for which natural means of control are known It has severely damaged several hundred square miles of pine plantations and is spreading rapidly. The Division of Entomology has imported and tested a virus found in Europe which offers great chance of providing effective control. The virus is first obtained from dead larvae, then is used to infect larvae at the Division's laboratoires. When a large supply of dead larvae has been thus obtained, they are ground and the powder is mixed with water. This liquid, when sprayed on infested plots, has given a high degree of control. Apparently one gallon (3,78 l.) of suspension is sufficient to spray one acre of pine woods from the air, and this can be done at a fraction of the cost of chemical spraying.

United Kingdom

• A survey of the fires in State forests in England, Scotland, and Wales shows that, during the past 20 years, there have been altogether 13,500 fires which have burned over 26,000 acres (10.522,2 ha.) of planted area, causing the loss of over £.550,000 and necessitating an expenditure on protection of £. 1,350,000. Carelessness of the general public in smoking and in the use of picnic fires has been a major cause, and sparks from railway engines are also an important factor. About 75 percent of the fires occurred between 11 A. M. and 5 P. M. and about 50 percent between 1 P. M. and 4 P. M. About two–thirds of the fires occurred in March, April and May. The number of fires which occurred during the same period in private woodlands is not known, but has certainly been large. A primary conclusion of the study is that continued and greater efforts are necessary to obtain a careful use of fire on the part of the general public.

United States of America

• *Fire Control Notes*, published quarterly by the United States Forest Service, provides concise reports on significant work under way and on experience gained on federal, state and privately protected forest lands. In a recent issue there are the following:

(1) The 1949 fires and trends of fire currents in the northeast, covering both state protected and national forest lands: a method has been developed whereby risk or probability of fires and flammability are expressed as a burning index and are measured separately as to their effect on the number of fires which occur. Risk is controllable by prevention measures, whereas flammability depends on weather conditions. In 1949 the cumulative burning index indicated that more fires could have been expected than in any other previous year since such measurements began. However, the number of fires was substantially less than expected, due to the downward trend in the ratio of risk. This points to more effective fire prevention. (2) The new forest fire protection program in Maine, a northeastern state, is a great improvement over the old and was introduced following the disastrous fires in 1947 Its main features are improved coordination through a measure of state control in organized towns, appointment by the state of town forest fire wardens, improved methods of paying cost of fire control through state participation, stronger measures for slash and brush disposal, and improved control over fire-using machinery in the woods. In addition, the warden service has been increased, more equipment obtained, and an improved statewide radio communication network has been set up. (3) In Texas a centralized radio dispatching system has been set up under which a single dispatcher will handle an entire district containing several counties, an improvement over the former system of dispatching by individual counties. This has made possible the sale of over 14,000 miles (22.526 km.) of telephone line no longer needed. Moreover, the new system will result in more effective use of facilities within the districts than heretofore. In two of the districts directional antennae are used because of peculiar radio communication problems. (4) In a Nevada national forest, a 2,000 acre (809.4 ha.) fire was suppressed by a small horse-mounted fire crew at a cost estimated at no more than one–tenth that of a foot crew. The horse–mounted crew avoided fatigue, was able to reach danger spots rapidly, and reduced the time lost going between camp and fire line. (5) During a California fire of large size and long duration, exhausted crews were given a chance to rest and clean up in a rest camp established on a public camp ground removed from the noise and disturbance of the main fire camps, after which they returned to the fire as effective combat forces. (6) Several new developments in equipment are reported on, including: (a) a tractor-tanker developed by the Depart

ment of Conservation of the state of Michigan; (b) a new hose roller developed in a national forest in Idaho; (c) a case for crosscut saws developed in a national forest in the southwest; (d) a new belt-type first-aid kit developed in a national forest in Wyoming; (e) a fire finder for use on lookout towers developed by the Department of Conservation, state of Minnesota; (f) a portable, collapsible fire table developed by the Forest Service in the Intermountain region; (g) a method of designating map locations so that they may be accurately identified from telephone messages developed by the Forest Service; (h) a firefog device which, when used in conjunction with flame throwers, makes it possible to burn safely inflammable material along railroad rights of way, developed by the Pacific Northwest region of the U.S. Forest Sercice; and (i) a cheap and readily assembled anemometer mast which may be used when measurements of wind velocities up to 30 feet (9,144 m.) above ground are required, developed by the Forest Service in the southeast. (7) The firebreaks in and around the Nebraska National Forest have been maintained for 40 years, since, without them, the planted forest could not survive. Over 650 miles (1.045,85 km.) are maintained by disking and burning to protect against fires originating both inside and outside the forest. Inside, the breaks divide the forest into areas no more than a mile square. (8) An annotated bibliography of recent significant pubblications in the field of forest fire control is given.

It is significant than the reported advances come from so wide a range of units and organizations and cover so many phases of the whole forest fire problem.

Forest Products and their Utilization

Canada

• Within the past ten years the manufacture of hardwood plywood has become an important wood industry in eastern Canada. Plywood is used largely in the furniture industry and this market might be greatly increased as a larger and more assured supply of plywood panels becomes available. Since plywood panels may be small, bolts as short as 2 feet (0,6096 m) can be used. It is thus estimated that at least 5 percent of the 10 million cords (21.200.000 m³) of fuel wood cut annually could be selected for use as veneer bolts. This amount would produce 200 million board feet (906.000 m³ (1.000 b.ft = 4,53 m³) of bolts which could be made into 600 million square feet (65.740.000 m²) of plywood. Although these amounts are greatly in excess of present or immediate prospective markets, it is evident that an excellent opportunity for expanding this use of hardwood exists.

Malaya

• Research laboratories are being built at Kepong, Selangor, for experimenting with Malayan woods in the production of paper. The laboratories, which are being built under a grant from the Colonial Welfare and Development Fund, should be completed by July 1951. Negotiations are going ahead for equipment from the United Kingdom, and the Secretary of State for the Colonies has been requested to appoint a wood chemist. The use of Malayan secondary hard woods for pulpmaking has been talked about for many years, but this is the first attempt to carry out practical experiments.

Poland

• Before the war Poland had a fairly well developed pulp and paper industry, but at the close of the war the industry was in utter collapse. Many of the plants were destroyed, and those which remained had had their equipment removed, or lacked raw materials with which to operate them. In 1945 the government took over 132 pulp and paper plants, but at first was only able to start up 3 paper plants, 1 cardboard and 1 pulp factory. By the end of 1945, however, 23 paper making plants, 11 cardboard, 18 pulpwood and 3 cellulose factories were in operation. By 1949 the Central Bureau of the Pulp and Paper Industry was operating 92 plants and the rest were in the process of reconstruction. The Central Bureau is situated in Lodz where it also has a laboratory for carrying out experiments in pulp and paper making. By 1947 the industry had resumed its export trade, at first chiefly of newsprint and cardboard, but by 1948 exports had been extended to a variety of products. Export trade is carried on exclusively through a central organization in Warsaw known as "Papexport." Some 32,000 workers are engaged in the pulp and paper industry and efforts are being made to raise their technical level. In the course of the six years beginning with 1950, the industry plans to double the volume of production and increase its value two and a half times. During the first two years, the aim is to improve and raise the productive capacities of existing plants, but in 1952 there is to be an expansion of the industry through modernization and the construction of new plants. At present the pulp and paper industry is centered in the southwestern part of the country, but in the next six years it is to be distributed more uniformly so as to be nearer the centers of consumption and sources of raw materials.

In the forests of Poland there i five times more pine than spruce Since it is expected that the amount of pulpwood needed by the indust will be trebled, seven times the p sent amount of pine will need to b cut; this in turn will mean increas use of the sulphate process. It i intended to manufacture all the new pulp and paper making machin ery in Poland. The industry issues two monthly magazines, both pub lished in Lodz, devoted to the problems of pulp and paper making; one is of a technical nature, the other is of a more popular character intended for workers engaged in the industry.

United States of America

• The only domestic source of vegetable tannin so far intensively exploited is the chestnut (*Castanea dentata*); in fact, all the material comes from dead trees, the supply of which should last only another 10 to 15 years and is irreplacable. On the other hand, South American quebracho forests (*Schinopsis Lorentzii*), if not systematically depleted, become more and more difficult to exploit because the easily accessible stands have been intensively cut. In addition, the South American leather industry is expanding rapidly and will progressively consume greater quantities of tannin; the Brazilian tannin industry has recently established vast plantations of Australian wattle for its own use. In 1939, 75 percent of the tanning materials used in the United States was imported quebracho and domestic chestnut wood. During the war, owing to restrictions on imports of some tanning materials, such as those obtained by processing mangrove bark (*Rhizophora mangle*) or from forests of myrobalans (*Terminalia chebula* and *Terminalia bellerica*), the United States had to promote the extraction of tannin from the bark of the chestnut oak (*Quercus montana*), *Tsuga canadensis*, and other materials of vegetable origin. Thus the tannin supply is creating a serious problem and research is therefore directed along two lines. The first aims at the increased utilization of the California tanbark oak (*Lithocarpus densiflora*), a large tree growing over an area of some 3 million acres (1.200.000 ha.) in California and certain parts of Oregon. There are 60 trees per acre on the average, each about 80 feet (24 m.) tall by 24 inches (60 cm.) in diameter. After felling, new trees sprout quickly from the live stumps and a cut is possible every 20 years. The bark contains 18 to 29 percent of tannin. It has been estimated that a tannin extractor plant, the minimum production of which should amount to 5,000 tons of pure tanni if run on an economically sound basis, would require an annual cut of 5.000 acres (2,000 ha.). This wood

is also satisfactory for the manufacture of either high-grade printing or superior wrapping paper, and wallboard. A pulp mill connected with the tannin extractor plant could produce 200 tons of paper pulp daily, which is economically possible. The second possibility is large-scale planting of wattle, particularly *Acacia decurrens*, vars., *normalis* and *mollis*, the latter often classified as a separate species, *Acacia mollissima*. These two varieties are very similar, both botanically and in their cultivation requirements. In California, mature specimens reach 100 ft. (30 m.) height and 18 inches (45 cm.) in diameter. They thrive on poor soils, provided the soils are well drained and porous. Ordinarily, 16 inches (40 cm.) of rainfall annually are required, but some are reported to prosper even without irrigation on as little as 8 inches (20 cm.) of rainfall. The plantations do not require any special care and the trees mature in 10 to 13 years. It has been estimated that the net annual financial return per hectare could be $120-$225, taking into consideration the value of both the bark and the wood which can be used in the manufacture of pulp. A project of this type would therefore be financially highly profitable.

United States of America

• The use of wood waste as a soil conditioner is receiving increased attention both in research and in actual practice, and recently experiments have been begun in the Northern Rocky Mountain area where at least half a million tons (m. t. 453,600) of sawdust is available annually. Indications in the Northern Rocky Mountain region are that, when the proper carbon-nitrogen ratio is attained, the results on farmland deficiency in humus are favourable. One effective way to use sawdust and shavings and to increase their value as soil conditioners is as bedding material for animals, since the wood material is usually cheap, has a high capacity to hold liquid, and is easy to handle. In using such material on crop lands it is often necessary to add a nitrogen fertilizer such as ammonium nitrate or ammonium sulphate at the rate of 75 lb. per ton (37.5 kg per m. ton) of bedding material to create the proper nitrogen-carbon balance. Wood chips may also be used if sufficiently small, and on many farms chips can be produced from wood otherwise wasted by the use of available portable chippers. Cost of such wood chip bedding is about one-third that of straw. Although further research and experience are needed, it is evident that there is great scope for the utilization of sawmill and wood waste in the necessary task of rebuilding humus content of many long-used agricultural soils.

Crown Zellerbach Corporation is building a large modern development laboratory for its central research department at Camas, Washington State. It will bring together in a complete experimental paper mill all the equipment necessary to convert wood to paper products and will house all the laboratory work that begins outside the research laboratory. The most important single piece of equipment will be an experimental paper machine, trimming 24 inches (60.96 cm.), equipped with flexible drive to permit wide variation of speed, which will test mill stock or pulp made in a large experimental digester. The laboratory will be staffed by present technical employees and additional specialized staff, and will be in operation by the end of 1951. The technical engineering staff of the Corporation will serve the new laboratory.

Union of Soviet Socialist Republics

• The turpentine industry has now been co-ordinated with the lumber industry under the Ministry of Forestry. The resin is obtained by tapping Scots pine (*Pinus sylvestris*) stands for a hort period before they are cut for timber. The problem now confronting foresters is how long this period should be ; whether light frequent tapping should be continued over a long period, for example for 25 to 30 years, as is successfully practised in southern France on the maritime pine (*Pinus pinaster*), or whether the trees should be tapped intensively over a short period prior to being cut for timber. The results of several investigations indicate that the prolonged French method of tapping is not practical for the Scots pine in the U.S.S.R. because of biological differences. The maritime pine grows faster and therefore the scars caused by turpentining heal over quickly without damaging the tree too much for its eventual use as lumber. In the case of the Scots pine, the incisions do not heal rapidly and if tapped for a long period it becomes heavily scarred and therefore of less value as lumber ; on the other hand, it can stand intensive tapping without loss of vitality. It has been proved that the accumulations of starch in the tree do not diminish, but remain the same whether it is tapped up to 80 percent or 30 percent of its potential capacity. It has also been found that the total amount of resin obtained from the tree over the entire period of tapping is about the same for both prolonged and short-term tapping. The cost of producing the same amount of resin, however, rises sharply with the period over which the tree is tapped, often by as much as 25 percent. The general conclusion is that the most practical and effective method of turpentining this species in the U.S.S.R. is to tap the trees for a period not longer than 15 years, allowing one year's rest after the first 10 years.

Forest Policy

Bulgaria

• Attempts are being made to enlarge the forested area by new plantations. In 1949, the area under forests is said to have increased by 46,200 ha. In the Dobrudja, the driest part of the country, over 350 km. of forest shelter belts have been planted. In 1950, 36,500 ha. were to be planted to forests and improvement work done on 40,000 ha. of forests. The Council of Ministers has approved the preparation of a 15-year reforestation plan.

Canada

• The Forest Act of 1948 of British Columbia contains, in Section 19, a provision which deserves special attention. Under this law, any farm owner who does not have on his land wood lots capable of producing 10,000 cu. ft. (283 m³) of wood per year may apply for a license to use a parcel of Crown forest land large enough to bring his total annual cut of lumber to this amount. Along the coast, on the basis of average forest productivity, each farmer can use a maximum of about 100 acres (40.47 ha.), and inland, about 250 acres (101.175 ha.). In no case, may the total area exceed 650 acres (263.055 ha.). Such wood lot licenses are granted with the proviso that :

(1) "The land shall be kept stocked with forest growth of saleable commercial species," which means that it is the responsibility of the farmer to see that the area is kept productive, the Forest Service supplying the necessary seedlings if he has to resort to replanting in order to obtain this result. (2) "The forests shall be managed for perpetual yield of an annual or periodical harvest of wood." (3) "The allowable cut shall be harvested annually or periodically."

Before a wood lot license can be granted, a very simple management plan must be prepared, either by the farmer, his agent or the Forest Service. In the event that the Forest Service is requested to prepare such a management plan, the farmer must aid in collecting the necessary field data. All forests for which a wood lot license has been granted are tax exempt. At felling time, the farmer is required to pay a royalty per unit of wood products extracted, and a similar royalty is also payable on forest products from private Crown-granted forests since 7 April 1887 ; and, of course, the stumpage is assessed by the Forest Service. The wood lot license automatically terminates upon the death of the licensee or if the farm is sold, unless the new owner expresses a desire to use the same license.

China

• Sinkiang is one of the largest provinces of China and is located in the western part of the country. The most important forests of Sinkiang are concentrated along the eastern slopes of the Tianshan mountain range. The area of these virgin forests is estimated at 3,478,000 mus (217,375 ha.). They extend from Kuchar to Kulja. The mountains of Tarbagatai, Kunlun and Altai are also covered with dense forests. The northern slopes of the Tianshan mountains as far as Kulja are timbered. South of Khami and Barkul the forests consists of red pine. The mountains of Bogdaola are covered with white pine forests.

• It is reported that the timber industry of Inner Mongolia, one of the important forest regions of China, has been revived. The forests cover an area of more than 7,000,000 ha. In the past these forests have been recklessly exploited.

Finland

• For a long time the common from of co-operation among Finnish forest owners has been through local associations, for the main purpose of employing permanent forest foremen, generally persons who have undergone two-years of forestry training. The foreman's duty is to advise association members, to assist in silvicultural work and in logging and to help members sell their forest products. The forest area of these associations is on the average from 20,000 to 25,000 acres (8,094 to 10,117.5 ha.). All of them receive government subsidies, but for the most part are financed by the members of the association. In order that all forest owners may benefit from the associations and to ensure adequate financing, the Finnish Parliament, in October 1940, passed a bill compelling all forest owners belonging to an association, except those whose forests have an annual yield of less than 20 m³, to pay an annual forest charge. This amounts to two to six percent of the calculated net return from forests used as a basis for income taxation. Forest owners who employ a permanent forest expert pay only a quarter of the usual charge. The contributions paid by each district are used by the association of forest owners for that district. Though forest owners are not compelled to join an association, it is hoped that through this scheme enough money will be collected to employ sufficient trained forest foremen for all forest ranges in Finland.

French West Indies

• Martinique and Guadeloupe acquired the status of French departments in January 1948 and their forest services have therefore been organized on the same pattern as the forest service of Metropolitan France with a conservator in charge. The total forested area of these two islands and their dependencies amounts to 110,000 hectares representing 38 percent of the total surface. However, in the case of Guadeloupe, this figure includes about 47,000 hectares of very degraded copsewood, valueless dry forests and open woods or orchards which are privately owned. French forestry legislation has been in force since 1 January 1948, with minor modifications, and large-scale surveys of state-owned forests have been undertaken.

In Martinique, forests are located on very hilly watersheds. Because of their protective role, extreme caution must be exercised in cutting. Difficulty of access, lack of sawing machinery and the primitive felling methods used, as well as the distances to be covered and the dispersal of valuable species in the natural forests make it necessary to use only the "jardinage" system. However, in the lower part of the country, a new method of forest improvement has been tried and has already produced excellent results on 300 hectares of land. By this method the land is leased for a period of 3 years to small farmers, each receiving a parcel of land from one half to one hectare in size; after the trees have been felled, the farmers are permitted to grow crops. Mixed with these crops and spaced at intervals of 4 x 4 m., the forest service plants valuable species, mainly Honduras mahogany (*Swietenia macrophylla*) from its own tree nurseries. The situation is very similar in Guadeloupe where there are only two machine-operated sawmills and systematic lumbering is practised only in the mangrove forests at the foot of the mountains. In both departments, large-scale projects are under consideration with a view to the future enrichment of these forests with valuable species; they include the construction of forests roads and the application of proper forest management practices.

New Caledonia

• The Government has submitted to the Assembly of the French Union a bill intended to ensure the protection of the forests of New Caledonia. These forests, which cover about one-seventh of the area of the island, are found only at 400 meters (about 1200 feet) above sea level. They have all the features of a more or less dense tropical forest depending on their exposure, the nature of the soil and the extent of erosion. The Forest and Water Service and the French Institute of Oceania have already accomplished much in respect of tree classification, inventory-taking and conservation work. The draft text prepared by the Government and adopted by the Assembly of the French Union without significant changes provides, first, for the classification of forests which are subject to forestry laws, according to the degree to which they are [illegible]ed, according to the importance of the species they contain, and [illegible]cording to their need for reforest[illegible]tion; secondly, for the regulation of felling, organizing and laying down directives for lumbering operations. Felling licenses are granted for areas from 100 to 500 ha. (250 to 1,250 acres) in size for a two-year period.

Norway

• The forest owners have their own marketing associations which arrange for the sale of timber. There are 19 such associations affiliated with the Norwegian Association of Forest Owners: they have about 30,000 members, representing more than half of the productive coniferous forest area. The members sell their timber to the marketing associations, which in turn sell to the buyers. Since the war, the marketing of timber has been subject to public control, and all sales contracts are therefore registered by the marketing associations. Timber prices are normally fixed by agreement between the Norwegian Association of Forest Owners and representatives of the sawmills and of the timber processing industry. These prices have to be approved by Government authorities. The basic prices for mechanical pulpwood and cellulose wood delivered at the watercourse have recent in years been as follows:

1947/48	39.00	kroner	per m³
1948/49	40.00	"	" "
1949/50	39.50	"	" "

In addition to these prices, in 1947/48 and 1948/49, an investment charge of 3 kroner and 4 kroner per m³ respectively was paid. For the season 1949/50, this charge varied between 0.50 kroner and 2.50 kroner per m³. A further 0.50 kroner per m³ was charged as a pension subscription. It is intended that sums collected shall be paid into a pension fund for forest workers. The corresponding price for 1950 has been fixed at 44.50 kroner per m³. The investment charge will vary from 1 kroner to 7 kroner per m³, and the pension subscription is 0.50 kroner per m³. The investment funds are administered by the forestry boards and paid out to the forest owners as and when they make forestry investments for which the fund can be utilized. This investment activity may consist of road building, hut building, forest tending and the like. The silviculture fund should also be mentioned in this connection. Under the Forest Protection Act of 1932, 2 percent of the sales value of timber has to be set aside for use in connection with silvicultural work, etc. Because of the lack of labor, the forest owners have not been able to utilize the whole of the investment funds and silviculture funds

and they have therefore a considerable amount on hand for future use.

Sweden

• With the results of the second national forest survey in sight, the Government has taken various steps to increase the future yield of the forests and to make better use of the available raw material. Among these measures is a new forest conservation law adopted in 1948 and promulgated on 1 June 1949, concerning forests owned by private corporations and individuals which comprise about 75 percent of Sweden's total forest area. Some of the most important provisions of this law are as follows: "Forest land, together with the forest growing thereon, shall be managed in such a way as to promote the appropriate use of the wood-production capacity of the soil, and thus ensure a satisfactory economic profit and, as far as possible, a sustained yield." The law aims at the appropriate (*Editor's note:* not the utmost!) use of the production capacity of the soil, and a new idea has been introduced, namely the principle of profitability. This protects a forest owner against having to make uneconomical investments in his forests, such as, for instance, paying out more capital for reforestation than warranted by the likely rate of interest. A further paragraph gives a definition of the term "forest land," which is understood to designate areas not essential for any different purpose, where the soil is suitable for wood production. Land which is at present either in large part or entirely unused is not considered as forest land if the soil is better suited to purposes other than forest growth, or if the land ought not to be used for wood production, because of special circumstances. However, areas where forests ought to be established as protection against drifting sand, shifting soil, mountain drift, or for similar reasons, are to be regarded as forest land. This provision may be of importance to secure afforestation of large areas of poorly wooded pasture land not necessary to modern agriculture, and of the socalled barren lands, such as the heaths (*Calluna*) in the southwest of Sweden. With regard to cutting regulations, the law distinguishes between forests which are capable of development and those which are not — in other words, between vigorous and non-vigorous forest stands. A vigorous forest must not, without the permission of the Forest Conservation Board, be cut except by selection cutting, and the cutting must be such as to secure the proper development of the forest. A forest is held to be "vigorous" or capable of development so long as it would, with proper tending, yield a greater profit than could be gained from immediate clear-felling. It may sometimes be difficult to determine whether a certain stand is vigorous or not. The forest owner may wish to cut it, while the Forest Conservation Board objects. In such cases the decisive factor is a calculation of the probable value increment of the stand under proper management. In non-vigorous forests, cutting may not be undertaken in such a way as to remove the possibility of further yields, nor may cutting be carried out in a manner that makes regeneration of the forests appreciably difficult. In this connection, certain social considerations are to be taken into account, such as the necessity of providing regular employment for forest workers and of maintaining a continuous supply of raw products. A sustained yield may be of importance to communities and parishes so as to provide a regular flow of communal income from taxes. Nevertheless, directions aiming at a sustained yield are not to be so strictly interpreted as to impede farmers wishing to take advantage of especially good market conditions. If cutting is carried out in defiance of the law, the Forest Conservation Board endeavors to reach an agreement with the owner of the forest. If this should prove impossible, the Board has the power to prohibit cutting. Such a prohibition, however, does not imply that no felling at all may be carried out; rather, the Board will give directions, as a rule by marking trees for felling, regarding the right methods of cutting with accompanying prohibition against felling trees other than the marked ones.

The following statutory provisions deal with compulsory reforestation. Should the density and composition of the remaining forest be considered unsatisfactory after logging, measures are to be taken to secure satisfactory reproduction in the cut-over area within a reasonable time. In this case, however, the principle of profitability is applied, so that the liability to undertake regeneration operations is limited in proportion to the yield capacity of the soil; in other words, the measures prescribed must be profitable in the long run. Certain calculations based on forest production research are necessary to determine in each case the practical application of this provision. In order to stimulate and facilitate long-term and costly improvements in privately owned forests, the Swedish Government has long made available various financial grants. In connection with the new forest conservation law some new rules have been formulated. Grants and loans are at present extended for the following types of improvements: ditching; road construction for truck transport of forest products, etc.; thinning in certain very dense forests which would not develop normally unless cleared; planting and other work to start forest production on land which has been bare from ancient times and on thinly wooded pasture land. Grants are given only in cases where the forest owner, by virtue of the forest conservation law, is under obligation to reforest after felling, and the Forest Conservation Board plans and inspects the operations. Grants usually represent the following percentages of labor costs: ditching, 40 percent; road construction, 25-50 percent; thinning and reforestation, 50 percent. Loans may, however, be granted to the full amount of the costs.

United States of America

• Open-cast or strip-mining of coal in Ohio began about 1915, and since 1940 the annual rate has increased rapidly until at present about half of the total coal produced is mined by this method. Altogether over 36,000 acres (14,569.2 ha.) of land have been treated in this way, resulting in spoil banks and debris piles on which affirmative reclamation measures are needed. The research conducted during the past years by the Central States Forest Experiment Station has, first of all, classified the strip-mined lands as to the texture and character of the spoils, including the aeration and waterholding capacity, the acidity and the age class of the spoils, and the present cover and use of the strip-mined lands. It is estimated that over 90 percent of the spoils could be converted readily to productive use. All of these basic factors have an important bearing on rehabilitation problems, since there is a wide range of conditions, each of which can best be handled by the use of certain tree species. Thus, much of the research has naturally dealt with the testing of species. In general, most of the strip-mined lands are more adaptable to forestry than to other uses, although a good many areas have great opportunities for the development of recreation and wildlife possibilities.

• Dr. H.L. Shantz, an eminent authority on ecology, has come to the conclusion that the use of theeconomic yardstick in determining the best use of land commonly leads to major disaster, such as stripping of land over coal beds, destroying mountain valleys to obtain gold from overlying gravels, replacing virgin redwood forests with barren moss and lichens in an attempt to perpetuate grazing, and destroying natural perennial grasses to obtain shortlived use of the land for wheat production, which leads to the formation of dust bowls. He holds the contrary view that the only safe criterion for judging permanent uses of land is that of ecology. But, in many cases, costly lessons learned from earlier experiences are not applied to current problems.

Zanzibar

• A recent survey and study of the forests of Zanzibar has added greatly to the knowledge of the forests and in the formulation of a program for their management. The

Protectorate is situated off the east coast of Africa, just south of the Equator and consists of two islands, Zanzibar and Pemba, with their separate archipelagoes. The two main islands have areas of 640 and 380 square miles (1,660 and 980 km²) respectively and are relatively small, flat coral islands. The climate is equable, marine and tropical. Rainfall varies from 45 to 75 inches (114 to 190 cm.) per year of which about half falls during March, April and May, a quarter in October, November and December, and the remainder fairly evenly distributed among the other months. Temperature variation is small with only 3 or 4 degrees' difference between mean annual minimum and mean annual maximum. Humidity is high, ranging from 76 to 87 percent. The mangrove forests result from upcut erosion which forms fresh mudbanks. On Zanzibar there are seven important species of mangrove and on Pemba six. Mangrove forests represent a successional stage with the climax probably being monsoon forests which come in as the mud dries out. On Zanzibar there are about 11,000 acres (4,500 ha.) of mangrove type forest, with 7,000 acres (2,800 ha.) of commercial quality trees for bark production. About 50 years are required to produce an 8-inch (20 cm.) tree, the usual minimum size for bark stripping, which indicates that growth is rather slower than on the mainland. By estimating the area and stocking of the mangrove on the sustained yield basis, it is estimated that about 1,800 tons of dried bark per year can safely be taken. The condition of the mangrove forests on Zanzibar is unsatisfactory since they have been overworked, and it may be necessary to decrease the size of trees to be stripped in order to maintain the industry during the period which will be required to improve the condition of the forests under the proposed management plan. On the island of Pemba there are about 30.000 acres (12,000 ha.) of mangrove, and about 5,000 tons yield on an efficient and sustained basis is estimated as correct. Past utilization practice has been extremely wasteful and the suggested figure presupposes full protection and full utilization. Despite varying opinions, it is clear that the catchment areas on both islands are suffering abnormal erosion and it is advocated that they should be placed under the full control of the Government so that wasteful practices such as burning, cutting of vegetation and cultivating of steep slopes may be halted and positive anti-erosion measures be initiated.

In order to meet timber requirements, it will be necessary to form plantations of suitable species and, since fuel supplies are deficient, particularly near towns, fuel reserves will be needed as well. Over half of Zanzibar and a quarter of Pemba are bush country on which the two main occupations of shifting cultivation and line burning result in destruction of the land. The rotation on shifting cultivation is only a few years and relatively little fuel suitable for line burning is left. Thus, it will be necessary, first, to limit the areas on which shifting cultivation is permitted and, next, to form plantations of fast-growing species available for industrial use as fuel. The small area of wet evergreen forest on Zanzibar has been so heavily exploited that little or no timber of any size remains and it is recommended that no further leases be issued or renewed. Some uses be found for *Pandanus* which hinders the growth of more valuable species, that a light working over of a fifth of the total area be made each year to stimulate regeneration and that, above all, clear-felling should not be permitted. On Pemba the practice of clear-felling would cause the land to revert to bush and this in turn decreases the ameliorating effect on cultivation. Additional legislation is required so that the Government may undertake and control the rehabilitation of the forests. Goat grazing should be controlled to avoid its development into the widespread menace that has been found in such areas as Cyprus and Malta. Legislation similar to the Indian Forest Act is needed and, in order to carry out the program suggested, some increase of the technical forestry staff is needed.

Fifty-six species of trees suitable for use as windbreaks and for other purposes have been studied and these deserve attention in the planting programs which must be undertaken to improve the forest conditions of the country. In addition, more precise inventories, mapping of the types and uses of land, etc., should be undertaken promptly. Recently made aerial photographs will, it is believed, be valuable for this purpose. It is evident that a prompt and energetic program is needed to restore and perpetuate the forests which are so important to the welfare of the islands.

Reviews

It is the policy of FAO to review those selected publications which appear to have a direct bearing on the current work of the Forestry Division.

LAND HUNGER IN MEXICO. Tom Gill. Pp. 86. Charles Lathrop Pack Forestry Foundation, Washington D.C. 1951. U.S. $2.00.

We are constantly being reminded that countries should protect and reforest their forest soils, improve their agricultural practices, and ensure more regular stream flow. This book attempts to translate these generalities into the specific measures that are needed in Mexico. It analyzes the factors that make up Mexico's land-use problem, not as separate independent elements, but in their interplay of agriculture, forest, and grazing land, and especially in relation to the population increase and the customs of the people themselves.

Admittedly there is no easy solution to a problem, which is daily becoming more serious as a result of the growth of population and the dwindling of suitable land. As possibilities for supporting the population are becoming less and less, the cures for its critical ills grow more difficult with time.

"Undoubtedly, part of the problem lies in the fact that 70 percent of Mexico's working population is concentrated on 7 percent of her land surface. This meagre 7 percent is Mexico's crop land. It is neither fertile, level, nor well watered, but it is all they have."

Water is one of Mexico's scarcest natural resources although there is a heavy rainfall in certain areas, such as those bordering on the Gulf of Mexico. Unfortunately in those zones where agricultural activity is most intense, or which are most suited to further development, the rainfall is insufficient. The start of the rainy season varies considerably from year to year but is always of short duration.

The author does not mince words in showing how the people, through their wasteful methods of farming the soil, cutting and burning their forests, and allowing their sheep and cattle to over-graze their land, have reduced and made uncertain

the meagre water supply without which life has become so precarious in Mexico.

On the basis of his analysis he concludes that four steps are basic to the building of a conservation movement in the country:

1. a resource inventory to determine the problem;
2. formulation of an integrated program of resource use;
3. creation of an organization and technical staff to administer the program;
4. education, information, demonstration, and conservation teaching in school curricula.

And, because of previous experience with such efforts, he stipulates that "whatever action is taken should be placed in competent and trustworthy hands."

He pays tribute to the valiant work of Miguel de Quevedo aimed at creating a national movement in forestry, and points out that if this effort had been applied to the boader task of rational management of all of Mexico's natural resources, it might perhaps have won wider support.

The book is short enough to appeal to busy policy-making officials of the government, its concise language and clear thinking, based on personal experience, and on the work of men who have sympathetically devoted their efforts to the welfare of Mexico, recommend it to careful consideration. This publication is about Mexico, but similar books need to be prepared for each of the countries where "land hunger, with its grim offspring, belly hunger, casts deeper and deeper shadows across the land."

PLANUNG UND KONTROLLE IM FORSTBETRIEB. (Planning and Controls in Forest Management). Prof. Hermann Knuchel. Pp. 346, 121 tables, 87 diagrams and maps. H.R. Sauerländer & Co., Aarau, Switzerland. 1950. Sw.fr.32.

Although the subject matter of this book normally falls into the field of Forest Regulation it markedly deviates from the generally accepted forest regulation practices. The essential point of divergence lies in stressing regulation of production in preference to regulation of the yield. The author rejects all forms of clear cutting and adheres fully to the principle of gradual selective cuttings (*Plenterprinzip*) as advocated by Gurnaud, Faore, Dannecker and others of the same school. Selective cuttings tend to create most favorable growing conditions for all trees and it is the *total* growth of all the trees in the stand that determines the productivity of the forest. This controlled method of management requires most careful silvicultural treatment of each individual tree and repeated light cuttings at short intervals. But above all it means a high degree of intensive forest management such as exists in Switzerland, but which is still lacking in most of the vast forest regions of North America or northeastern Europe which are just emerging from a state of long neglect.

PRINCIPLES OF SILVICULTURE. Frederick S. Baker. Pp. 414 + 43 tables, 127 graphs. McGraw-Hill Book Co., New York, Toronto, London. 1950 (American Forestry Series). $5.00.

In the teaching of silviculture in American forest schools, the greatest emphasis has generally been on practice, using the growing body of knowledge acquired by research and experience and dealing with the many forest regions and types of the country. For a glimpse into the underlying biological facts and principles, students have had to depend on such subjects as plant physiology and soils, and on courses dealing primarily with agriculture. But in recent years forest schools have been generally teaching the principles as a separate course.

This development coupled with rapid advances in plant and soil sciences, makes the book a timely addition to the American Forestry Series. Many of the basic facts are imperfectly understood and opposing views are not uncommon on the relative influences of heat, light moisture and soil, on their interrelation in controlling growth and seed formation, and on the nature and processes of photosynthesis. But an up-to-date account of the accumulated evidence, a judicial weighing of opposing interpretations and doctrines, clear cut identification of the areas in which silviculture may manipulate the basic controls — such as the factor of light in its effects on seed production and seedling establishment — provide a thoroughly sound basis for students to learn what is now known of the complex natural foundations of silviculture.

The author has wisely drawn on the valuable work which has been done for many decades in continental Europe, in addition to what has been published in English. A bibliography of over 500 titles lists the authorities on which the work is based. The book is well arranged, it deals first with forms and types of forests and the trees in them, then, with the basic physiological reactions of trees to water, light, nutrients, etc., and last, with the growth and development of forests from seed to old age. It would seem that the growing science of forest genetics — at least these aspects dealing with elite trees and stands — might have been covered. The author is, however, primarily concerned with facts regarding natural rather than planted forests. The book is well illustrated and indexed.

LAND PROBLEMS AND POLICIES. John F. Timmons and William G. Murray Pp. 298. Iowa State College Press, Ames, Iowa, U.S.A. 1950. $3.50.

In the United States of America there is no genuine and comprehensive land policy. Instead, there are a large number of national, state and local programs, with or without reasoned bases of policy, each dealing with one kind of land or land use (farm, forest, range, wildlife or recreation), or with one activity affecting land use (irrigation, reclamation, conservation practices on farms, price support, soil conservation, etc.). This situation has grown out of the historical process of occupying and using lands principally on the basis of individual choice, of seeing problems of one kind or another develop and arouse public attention, of legislative action recogniziing individual problems and setting up institutions to deal with them. Of the national agencies, probably the Forest Service, with a broad charter, deals with more kinds of problems in more ways than do others, and particularly so in contrast to the several agencies concerned with agricultural lands and problems.

Conflicts in philosophy, viewpoint, policy, and program have inevitably developed, often supported by the basic laws and accentuated by the self-contained processes of policy and program formulation which official agencies tend to build up. Many policies and programs were originally developed to meet real or postulated emergencies and have failed to change as situations change. The advancement of programs often depends more on publicity and popularization than on an impartial weighing of urgency and merit against competitors. At the moment, the construction of great dams and publicly supported soil conservation on farms are favored programs while very slow progress is being made in attracting attention to the problems of forest and range on water producing areas.

There is merit then in serious and thoughtful attempts by competent men to see and analyze the problems of land and its use, as has been done in *Land Problems and Policies*; to set forth the elements of a land policy which might help to resolve some of the present conflicts, inconsistencies, and irrational results of a single line of approach to a many-sided problem; to suggest the kind of machinery which might evaluate specific proposals considered separately and weigh their merits as related to present policies and programs.

The Institute of Land Economics, organized by the Iowa State College in 1949, has attempted these tasks. A total of sixteen papers by various authorities covers the main features of the over-all problem, including forest, range, water, wildlife and recreation. The section dealing with public interest in private land is of particular interest, emphasizing as it does that it is not somuch a question of the fact of public interest as of how to determine and enforce protection of public interest. These are matters of judgment at a given time, and local opinion must necessarily be consulted.

Determination of objectives of land policy cannot be in terms of rigid formulae, and indeed cannot deal with land alone but must be consistent with the general purposes and aims of national policy. This conclusion lends weight to the suggestion that new types of governmental organization need to be developed to synthesize the existing dissonant policies, and to work out a fair basis for evaluating competitive programs. One idea for such an organization is a Natural Resources Council, made up of men of unquestioned competence and impartiality, with special knowledge of the various aspects of land and land use, operating directly under the President, supported by the necessary staff, and with the power to call on official agencies. If such a national body were paralleled by comparable state organizations, there would be a reasonable chance of progress being made in resolving the present conflicts and inconsistencies.

Wisely, the Institute has not attempted to give definitive answers. Instead, it brings out the different views of technicians, economists, and sociologists it sets forth the scope and ramifications of the great problem of co-ordination, the possibilities of developing effective co-ordinating machinery, and the importance of further research; it calls attention to proven methods of analyzing problems and working out solutions, and emphasizes the necessity of considering in a democracy local views and needs.

Foresters, dealing as they do with a major part of the earth's productive land, which is often in competitive demand for other purposes, and accustomed as they are to thinking in long-range terms, will find here a stimulating discussion which may aid them in seeing their work as part of the greater problem of land and water conservation.

A WATER POLICY FOR THE AMERICAN PEOPLE. Water Resources Policy Commission. Vol. 1, Pp. 445. U.S. Government Printing Office, Washington, D.C., U.S.A. 1950. $0.15.

The broad charter of the President's Water Resources Policy Commission, established in January 1950, and the character and ability of the seven men appointed to it, gave promise that the results of the Commission's work would be something more than just another report. Volume I is thus the basis for appraising accomplishment in relation to need and opportunity.

The Commission dealt with four main problems: (1) the extent and character of federal government participation in major water resources programs; (2) an appraisal of the priority of water resources programs from the standpoint of economic and social need; (3) criteria and standards for evaluating the feasibility of water resources projects; and (4) desirable legislation or changes in existing legislation relating to the development, utilization, and conservation of water resources. The related problems of governmental organization had already been covered by the Hoover Commission.

The Commission extended its investigations over the widest possible field. Statements were obtained from the large number of federal, state, and local governmental agencies and private organizations dealing with or having an interest in water problems; experts in the universities and elsewhere were consulted; public hearings were held. Selected experts from the federal agencies were loaned to the Commission; a few authorities served as consultants: a small, carefully selected, staff was chosen.

Twelve committees were set up, each presided over by a staff officer. The committees covered: (1) evaluation of selected typical water resources projects already constructed to furnish a guide to future projects selection policy; (2) objectives of water resources projects, co-ordination of planning, and project selection; (3) determination of the minimum essential background information necessary for sound planning of river basin projects and programs; (4) formulation of acceptable principles and procedures for determining benefits and costs of water resources projects; (5) project reimbursement; (6) water resources policies involving land-use economics, particularly of agricultural lands; (7) federal power policy; (8) recreation and water resources; (9) inland water navigation projects and national transportation policy; (10) domestic and industrial water supply; (11) major river basin program analysis; and (12) water resources law. The chairmen and Commissioner as a group analyzed over-all water policies. The Commissioners prepared this report, in 19 chapters, in each of which recommendations on policy are developed. The chapters are: (1) Regional development; (2) National objectives; (3) Unity in planning; (4) Evaluation; (5) Reimbursement; (6) A resources investment program; (7) The need for basic information; (8) Surface and ground water; (9) Watershed management; (10) Flood management; (11) Land reclamation; (12) Domestic and industrial water supply; (13) Pollution control; (14) Inland and intra-coastal waterways; (15) Hydroelectric power; (16) Recreation; (17) Fish and wildlife; (18) Conservation education; and (19) Legal aspects. The recommendations embody the Commission's own ideas, and are clearly and forcefully stated.

Foresters will find chapters on watershed management, recreation, fish and wildlife and conservation education of particular and direct interest. It is found, for example, that some agricultural programs neither support nor run counter to the watershed management and soil conservation programs — all in the United States Department of Agriculture. But foresters can hardly neglect any chapter — the interrelations among the necessarily arbitrary subjects are too closely drawn to warrant partial reading. Appendices on "Standards of Basic Data" and "Evaluation of Constructed Projects" are of absorbing interest.

Out of it all comes a "National Water Resources Policy" with a summary of recommendations. It is compellingly clear, says the Commission, that there are serious wastes in exploiting nature; that water is the key natural resource; that water is limited in relation to needs for its use; that conservation of water resources is inextricably bound up with conservation of land resources, and if one is neglected the other suffers. Civilizations are built on a combination of water, land and people; policy must serve people and they must share in forming policy. This is a time for decision and action, on a comprehensive, rather than a piecemeal basis, with clearly defined goals and with conservation replacing existing exploitation, all to the end that the nation may remain strong in an expanding economy and thereby serve its own and many other peoples.

Policy rests on a framework of principles. Regional and national goals must be defined; the river basin as a whole is the unit of planning; simple procedures for measuring the worth-whileness of investments are needed; everyone who enjoys the advantages of federal investment should be treated alike in repayment procedures; financing of water resource programs should be on a program basis; planners of river basin programs should be provided with all necessary facts; sound management of watersheds, underground waters and floodwaters is required; all the services of water resources should be used for national strength.

Among the 70 specific policy proposals which derive from the principles, two will be especially welcome to foresters: (1) watershed management should be included as a principal objective in planning and developing basin programs and should have available enough funds to bring economically controllable deterioration under control within a reasonable time; (2) all federal programs and the mining laws should be adjusted to strengthen watershed management.

A forthcoming second volume of the report will analize ten selected river basins and examine whether conditions there justify application of the proposed principles and policies, and, next, to what extent principle and policy are applicable to individual basins. A third volume will propose and justify a single water policy law. It is already indicated that a reviewing and co-ordinating commission for each major basin, and an over-all national review board, will be proposed, unless action under the Hoover Commission report makes this unnecessary.

The Commission has redeemed fully and well the promise implied in its charter and membership. Its proposals cover competently and boldly both of the major elements and the water and land problem as an indivisible whole, they are endowed with a sense of urgency fitting to the time of need, and are based on the realities of political action in a democracy.

The first comprehensive water resources policy was formulated over 40 years ago as the fullest expression of the conservation doctrine developed by Gifford Pinchot and was fully supported by President Theodore Roosevelt. The action deriving from it, however, broke up into many separate measures, and as a result the solution of the land and water problem as a whole suffered.

This Commission has found the same problems, intensified and aggravated, rather than new ones. Its great contribution, the finest in the national resources field since 1909, is to start again from the principle of unity and to develop a body of policy based on it. If public opinion and political action can rise to the level attained by the Commission, by weighing judicially the competitive demands of agencies and organizations, while refusing to be controlled by them, there may come into being an urgently required and competent course of unified public action. Foresters everywhere must have an important part in any such program.

PLYWOODS : THEIR DEVELOPMENT AND MANUFACTURE. A.D.Wood & T.G. Linn. Pp. 547 illus. W. & A.K. Johnston, Ltd., Edinburgh and London. 1950. $4.00.

The growth in the production of plywood, the development of new sources of supply, the increase in the number of woods used, the expanding technology of manufacture and the need for using proved methods, combine to justify a comprehensive and up-to-date book on plywood. This publication should be of value to manufacturers, the trade, users of plywood, architects, foresters, and laymen.

It is divided into ten parts. Part I covers development and history, which goes back to the ancient days of the Pharaohs ; definitions of veneer and plywood ; general data on sources of supply. Part II covers the physical properties of wood and plywood, with chapters on the structure of wood and the development of figure in wood, on moisture in wood, on the chief characteristics of wood and plywood, and the ways in which figure is disclosed by cutting into veneer. Part III deals with the many steps in the manufacture of multiply, including preparation of logs ; conversion into veneer by several methods of cutting ; trimming to width ; plywood production processes ; drying of veneers ; jointing and repairing veneers ; assembling; adhesive and their application; presses; pressing; finishing operations; manufacturing defects. Part IV covers development and manufacture of laminboard, blockboard, composite board, technical plywood, and specialties.

Part V is concerned with grading testing, packing, and storing. Part VI discusses the plywood-producing countries of the world arranged by continents and gives data on production facilities, output, species used, etc.

Part VII gives data on the species used for plywood, divided into commercial plywoods, including laminboard and blockboard ; other woods used in plywood manufacture; decorative veneers. For each species, scientific and common names, alternative trade names, chief sources of supply, description, working qualities, uses, and dimensions and construction of plywood grades, are given. Finally Part VIII deals with the plywood trade in the United Kingdom, and Part IX covers the development of wall panelling. Part X, while not giving all the information availlable in specialized works, deals with the applications of plywood in veneering ; furniture manufacture and general woodwork ; shipbuilding and light craft construction ; utility services and motors ; boxes, barrels, baskets, and trays ; exterior work.

An appendix includes terms and definitions, constructional details, technical data, and an index.

The typography is excellent and well-chosen illustrations add to the interest and value of the book. This is the first revision of the original text and it is to be hoped that later revisions will be made to keep pace with advances in the manufacture, and changes in the sources of supply and uses of plywood.

MODERN WOOD ADHESIVES. Thomas D. Perry. Pp. 208. Pitman Publishing Corporation, New York and Chicago. 1944. $4.00.

The development, technical application and increased uses of adhesives have contributed greatly to the rapidly expanding use, both in volume and kind, of veneers and plywood during recent years. Several types of glue and adhesives are in use, including animal glues, bone and hide ; vegetable glues, cassava; casein glues ; soybean meal glues ; synthetic-resin adhesives phenolic and urea ; silicate of soda glues ; blood-albumin glues ; and prepared, mixed, and proprietary glues. Each of these has its own characteristics, ease or difficulty of application, adaptability to cold or hot press methods, advantages and limitations.

In comparing glues, the service conditions of the product are particularly important in determining adhesive quality and durability. Climatic durability under extremes of heat, cold or exposure to moisture is necessary in many products. In addition, simplicity and convenience of application of the adhesive in the manufacturing process must be considered. Workability under tools is also a factor of comparison, and glues differ greatly in this respect. Although cost of various glues per 1,000 sq. ft. of single glue joint differ in a ratio of 1 to 7, the cost is a relatively small fraction of total cost and should not be over-emphasized in making choices.

The most significant generalization is that no one glue or adhesive is superior to all others in every respect. Each has its own place and purpose, general or special, and its own characteristics, cost, etc. Detailed information on each is given in this reference manual, together with data on methods of comparison, on mixing and spreading equipment, on pressures in glueing, on adhesion secured by heat, on re-dries for glue solvents, on impregnation, and on glue testing. This information should make the book valuable to engineers, architects, designers, manufacturers and users of glue and adhesives in many of the wood-using industries. Foresters may not need to learn details, but it is well to know that an advanced technology in adhesives does exist, and that this offers many possibilities for the efficient and profitable use of forests in the plywood industry.

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